AGRICULTURAL ENGINEERING

DECEMBER · 1946

ASAE

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

AGRICULTURAL ENGINEERING

Established 1920

CONTENTS FOR DECEMBER 1946

VOL. 27, NO. 12

This Journal is owned, edited, and published monthly by the American Society of Agricultural Engineers.

Editorial and advertising departments at the executive office of the Society, Saint Joseph, Michigan. Publication office at Benton Harbor, Michigan.

The A.S.A.E. is a member of

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

AUDIT BUREAU OF CIRCULATIONS

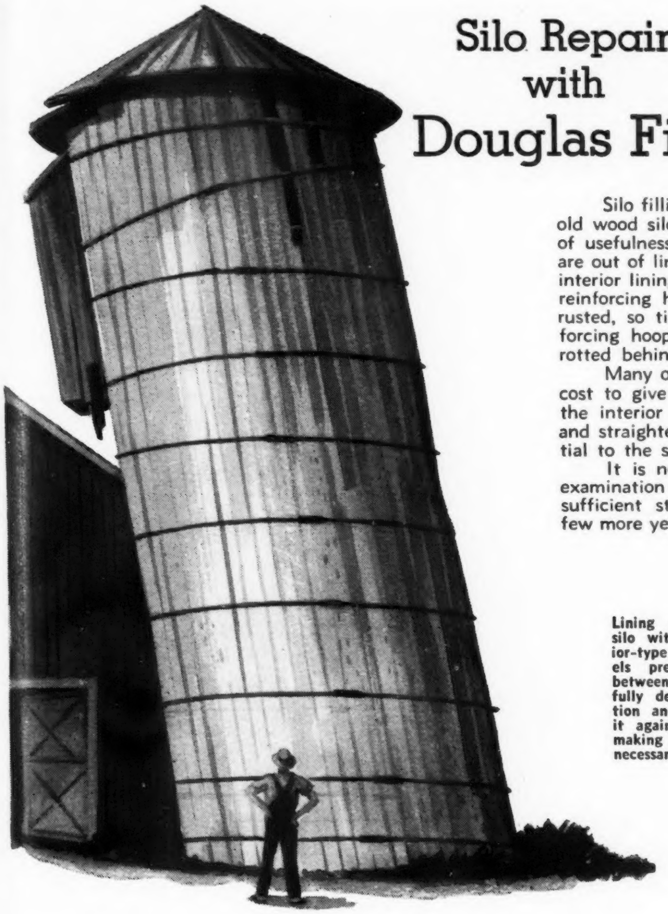
ADVERTISING REPRESENTATIVES

Chicago, 2: DWIGHT H. EARLY
100 North LaSalle St.
Telephone: CENtral 2184

New York, 17: A. M. WILLCOX
420 Lexington Ave.
Tele: LEXington 2-4735

SUBSCRIPTION PRICE: $3.00 a year, plus an extra postage charge to all countries to which the second-class postage rate does not apply; to A.S.A.E. members anywhere, $2.00 a year. Single copies (current), 30 cents each.

POST OFFICE ENTRY: Entered as second class matter, October 28, 1933, at the post office at Benton Harbor, Michigan, under the Act of August 24, 1912. Additional entry at St. Joseph, Michigan. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.



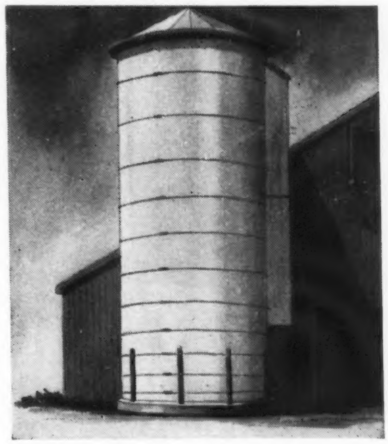
Silo Repair with Douglas Fir Plywood

Silo filling this fall has accentuated the fact that many old wood silos have about reached the end of their period of usefulness. After twenty or more years of service they are out of line, have crushed and rotted staves or studs and interior lining boards, and may be rotted at the base. Steel reinforcing hoops may be badly corroded and the threads rusted, so tightening is impossible. Laminated wood reinforcing hoops may be loosened or rotted, and the staves rotted behind them.

Many of these silos can be reconditioned at reasonable cost to give another ten years or more of service. Lining the interior walls with Douglas fir plywood both stiffens and straightens the structure, and gives a tight wall essential to the storage of ensilage.

It is necessary, of course, that a careful preliminary examination of the structure be made. Unless it retains sufficient structural strength to withstand loading for a few more years, reconditioning is not justifiable.

Lining a wood stave silo with large Exterior-type plywood panels prevents slippage between staves. Carefully designed foundation anchors will hold it against wind loads, making guy wires unnecessary.



Recommended Procedure

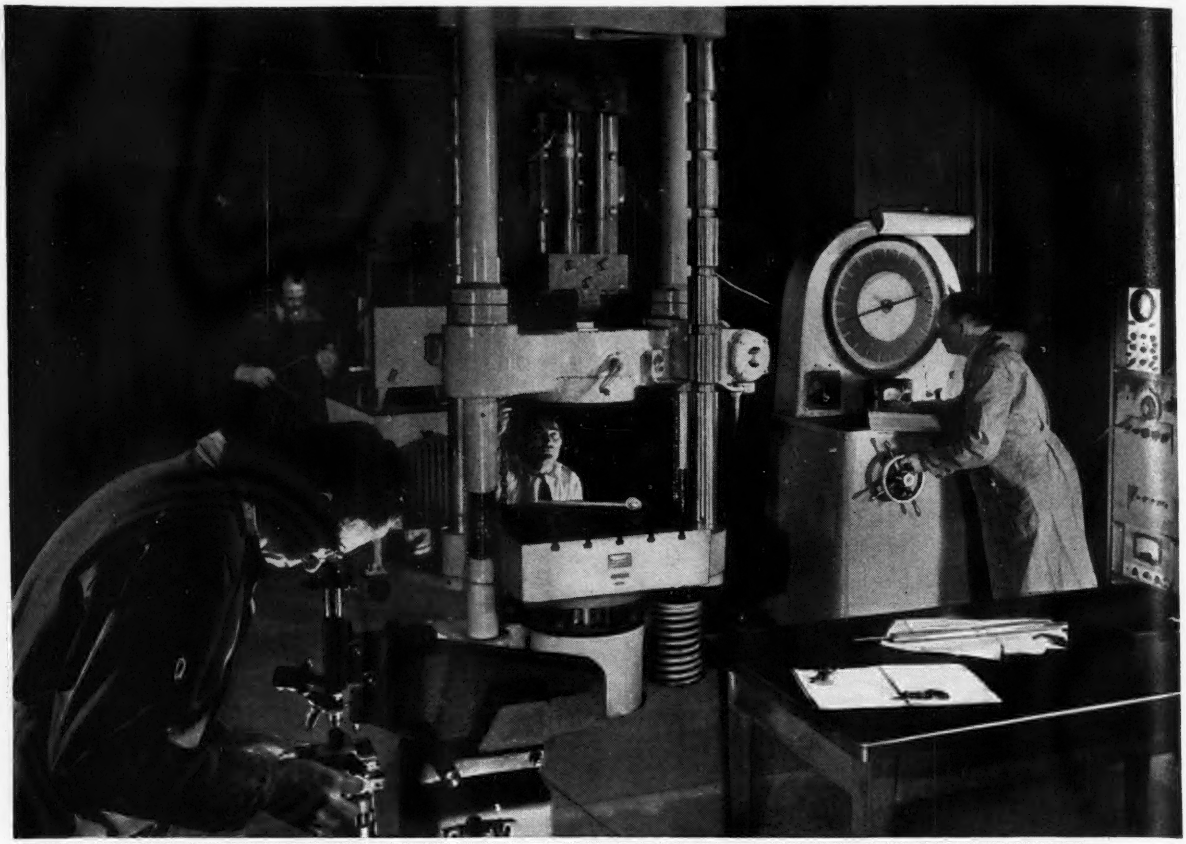
1. Make careful examination of both the shell and the reinforcing to determine the extent of deterioration.
2. If reconditioning is warranted pull the structure into vertical position. If the bottom is badly rotted cut off the lower two feet, supporting the superstructure on jacks. Repair or rebuild foundation, lower the silo to a new seat and anchor it securely to the foundation. Tighten the guy wires. Examine the wood staves or studs and lining boards carefully and replace those badly crushed, broken or rotted. Replace the steel reinforcing hoops, especially those near the bottom, if the cross sectional area has been materially reduced by rusting. Tighten the steel hoops as much as the threads and condition of the staves will permit. Add any additional reinforcement. If wooden hoops were used, and any of these are in questionable condition, new laminated wood hoops should be built. These may be constructed adjacent to the old ones by wrapping and nailing individual laminae around the shell to give the same hoop cross section.
3. Place 4′ x 8′ x ¼″ panels of Exterior type, Sound-One-Side grade, fir plywood inside the silo through doors or top. Place the first panel of the lower course vertically against the door jamb and nail this edge. Using a loose 2″ x 4″ vertically against the panel with another timber braced against the opposite silo wall, it is possible to force the panel against the wall for nailing. Nails should be 4d or 6d depending on the silo wall thickness, and should be driven into each stave or board spaced approximately 6″ apart along the panel edges and 12″ vertically through the center. Succeeding panels of this lower course may be butt-jointed against the preceding panel, and nailed. Successive courses of panels are applied, butting their lower edges to the top of those in lower courses.

   If the silo is not straight and plumb, and many old stave structures have been tightened to a smaller diameter at mid-height than at top and bottom, another lay-up system may be required. Each panel may be plumbed and the edge trimmed to fit against the preceding panel, at the same time keeping the top of the course level. Or, it is feasible to overlap each panel approximately 2″ to take up irregularities, keeping the top of the course level. Overlapping the panels adds to the reinforcement.

   After the wall has been covered, the plywood lining may be coated with emulsified asphalt, asphalt paint or some other acid-resisting paint. This coating should be renewed at two or three year intervals to prevent rusting of the galvanized or iron wire nail heads. If copper nails have been used the panels may be left untreated.
4. Exterior type, ¾″ panels may be cut and fitted for tight doors. For the minimum deflection the panels should be cut so the face-grain will extend across the opening, or the greatest distance between supports.
5. Exterior type ⅜″ panels may be used for the roofing and chute.

DOUGLAS FIR DOUGLAS FIR PLYWOOD LARGE, LIGHT, STRONG. Real Wood PANELS **PLYWOOD ASSOCIATION**

Tacoma 2, Washington



EDITORIAL

The Airplane as Farm Equipment

NOW that the airplane is selling itself to increasing numbers of farmers as fast farm transportation, it demands agricultural engineering attention as an item of engineered equipment influencing farm operating economy.

Probably the basic design of planes may never be specialized for farm application any more than has the basic design of motor trucks. Agricultural engineers will be called on, not to engineer its design and production, but its application to farm use. The plane manufacturers and their representatives, except as they include agricultural engineers, will be able to give a farmer only the sketchiest guidance as to farm conditions and operations which may indicate opportunity for profitable use of a plane; and circumstances under which its use could not be profitable, and should be postponed or frankly classed as a luxury.

By way of a start to obtain data on farm use of planes, which may be of considerable reference value to agricultural engineers, we invite any contributions which may be available as to costs and uses.

What we have in mind as to costs includes costs per mile as influenced by extent of use, and covering fixed costs of investment in plane, landing and storage facilities, depreciation, obsolescence, insurance, and other cost of ownership items, as well as direct costs for fuel, lubricants, maintenance, and possibly value of the pilot's time. It includes cost per mile and time savings as influenced by length of trip as compared with available road, rail or boat transportation for a comparable load. The present or prospective farm pilot who expects his plane to pay for itself will need to recognize its decreasing advantage for short trips, as influenced by warm-up time, take-off and landing time, and time for portions of the trip which cannot be covered by plane.

It is going to be impracticable to draw sharp margins between profit and loss in farm operation of planes. Where the plane is available, it is going to be used for recreation as well as business trips. It is going to take the farmer to places and events he would miss without it, and the profit or loss, if any, may not show up for several years. Farm planes will be used to save some lives, and they will take some lives. The time factor is of tremendous importance in some farm operations, and almost negligible in others. The plane may save important time in some cases, and lose it in others by being weathered in.

What we have in mind as to possible uses includes questions of plane modifications, auxiliary equipment, methods, capacities, and minimum scale of operations for economic use of planes, not only for high-speed personal and commodity transportation, but for spraying, dusting, and seeding jobs; for quick visual and photographic surveys of conditions on extended or scattered acreages; for hunting predators; for getting weather data; or, who knows, possibly even to provide a sound rain-making technique by some such method as scattering shaved solid carbon dioxide through clouds.

All of these variables, intangibles, and potential uses only emphasize the help needed by farmers who may be near the margin as to the economy of using a plane, to decide whether to invest in it or in a new barn, tractor, or some unit of electrical equipment.

Agricultural engineers can help considerably to develop the sound economic farm use of planes; and to discourage inopportune investment in them at the expense of other farm improvements. The first step is to begin to accumulate data of the type indicated.

Service Agricultural Engineers

WHAT about the training of service agricultural engineers, the engineers who are in closest contact with farmers and with specific applications of engineering in agriculture, the men who do the field work?

At least one A.S.A.E. member has been led to raise this question, by the emphasis which has been placed on training of professional agricultural engineers.

This boils down, we believe, to the question of whether service and field work is simply a step in professional development, or a distinct field of application.

We like the picture of agricultural engineering service as a field of application in which a man might aspire to as high a degree of professional development, achievement, and usefulness as in design, research, teaching, or any other field of agricultural engineering application.

We dislike a class-conscious picture of agricultural engineering service as a specific caste level of achievement and performance.

It is true that service or field experience serves as an important part of the training of many agricultural engineers in their progress to full professional status in various fields of application.

It is also true that agricultural engineers in the upper brackets of service work qualify and identify themselves as professional agricultural engineers.

And, offhand, we do not recall any professional agricultural engineers who are too class conscious to take off their white shirts and get their hands dirty on occasion, when it will help them to get or impart information or to expedite other desired results.

Dean Chapman recently gave us some clear indications of the vital importance of engineering services in pushing agricultural engineering means to their logical application in economic farm practice.* Service to the farmer is the payoff in agricultural engineering.

Now, to amplify our original question, do our professional agricultural engineering curriculums provide a suitable foundation for beginning work in the service field? We are inclined to believe that they do, particularly where the graduates are farm boys.

Are there enough graduates of professional courses, and do they stay in service work long enough to meet the personnel requirements of this field? Apparently not. In addition to the visible opportunities for potential expansion, there are specific positions remaining open for months, waiting to be filled by qualified men.

Can graduates in agriculture who major in agricultural engineering help meet the personnel requirements? Undoubtedly they can. They have in the past, and some attention is being given to specialized training for agricultural engineering service work.

We make no pretense of knowing what training might best meet the requirements for agricultural engineering service work. We will, however, venture the opinion that a well-balanced and rapid development of the whole field of agricultural engineering requires a strong service group — strong in numbers and intelligence, in agricultural and engineering technology, and in human relations.

*"Some Engineering Implications in Agricultural Industries and Services," by Paul W. Chapman, AGRICULTURAL ENGINEERING, August, 1946.

AGRICULTURAL ENGINEERING

VOL. 27 DECEMBER, 1946 No. 12

The Development of Sugar Beet Planting Equipment

By S. W. McBirney
MEMBER A.S.A.E.

RESEARCH and development work on sugar beet planting equipment is being carried on as an indirect approach to the solution of one of the most important problems in the mechanization of sugar beet production, that is, mechanization of thinning. In fact, with the present rapid development of sugar beet harvesters, this problem of mechanization of thinning, or of saving thinning labor during this period of peak labor demand, is perhaps the present major problem of sugar beet mechanization. Of the hundred or so man-hours required for producing an acre of sugar beets in this country where mechanization of thinning and harvesting is not practiced, about one-third is required for hand thinning and hoeing the crop.

In our early investigations of mechanization of the thinning operation, beginning about 1931, and particularly in our work from 1933 to 1936, it was found that the sugar beet seedling stands then accepted as desirable were not well suited to mechanization. The seedlings were not uniformly distributed in the rows and were generally much too thick so that blocks left by machine thinning largely contained several seedlings and would not produce a satisfactory crop of marketable size beets without further hand thinning. Preliminary careful hand planting of small beet plots convinced us that much of the solution of mechanical thinning lay in improved planting.

In most of the planter development so far major emphasis has been given to investigating those planter characteristics affecting seed distribution and to improving the uniformity of seed distribution. Single-seed planting with several different types of planters has resulted. The earlier planters of this type were described in a paper by the late E. M. Mervine and me which was presented before the 1939 annual meeting of the American Society of Agricultural Engineers. These earlier single-seed planters were largely of special types such as pickup cup planters with seed cups on chains or on vertical-plane disks. Since then it has been found that conventional plate-type planters could be adapted to single-seed planting and would give practically as good seed distribution as the more elaborate or complicated types of planters.

Manufacturers have closely followed the sugar beet planter development of the U. S. Department of Agriculture, the state experiment stations, the sugar companies, and others, as well as having done development work themselves and have been very progressive in accepting and adopting proven improvements. Practically all the commercial sugar beet planters built and sold today are of the single-seed planting type, most of them being of the horizontal seed plate-type with plate thickness and seed cell size suited to the size of seed used. Some beet planters with vertical-plane seed plates and seed cells correctly sized for the seed or with other types of plates also are being built.

Experimental work has shown that the best distribution and other results can be obtained by using seed of a comparatively small range in size, usually with the range not over 3/64 in in the seed sizes commonly used, and using seed cells 1/64 in larger than the largest size of seed in the size range used, for example, 11/64-in diameter seed cells for 7 to 10/64-in seed. A seed plate thickness of 1/8 in giving a seed cell of that depth has been found thick enough for seed up to 10 to 11/64 in maximum size as the seed are usually thinner in one dimension and the 1/8-in plate avoids getting too many cells with two seeds and too much seed grinding resulting from the top seed of a double being cut in two. Suitable seed knockers to eject positively each seed are also necessary. These findings now have been put into practice by manufacturers of most commercial beet planters. By changing seed plates and related equipment, in the horizontal plate type of planters particularly, and by changing row spacings in some cases, these planters can be used for other seeds and thereby increase the usefulness of the machine and the factory production of the line.

The success of the development of single-seed planting equipment with its associated improvement in uniformity of seed and seedling distribution in the field made it evident that seeding rates could be reduced without causing large gaps in the rows of beet seedlings and thus produce seedling stands which could be thinned by hand much faster than normally, or machine-thinned without leaving so many multiple beet clumps. Seeding rates, which on commercial plantings were 18 to 20 lb per acre, were successively reduced on test plantings with single-seed equipment and by 1940 and again in 1941 we had satisfactory plantings, thinned stands and yields with seeding rates ranging down to 3 lb per acre.

Along with the development of single-seed planters came the need and develop-

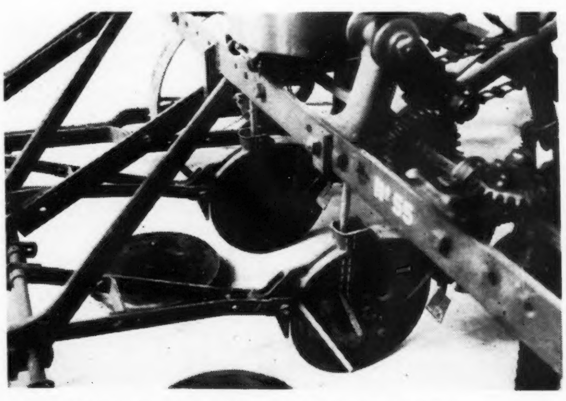


Fig. 1 This picture shows the sugar beet planter disk furrow openers with left disks removed. The far opener is equipped with a short, small-diameter, smooth, straight seed tube. The nearer opener has a long, smooth, slightly curved tube from which seeds drop into the opened furrow rather than into the V between the disks. Both types of tubes improve the uniformity of seed distribution as compared to regular, flexible ribbon tubes. The nearer opener is also equipped with a scraper bar between the disks to smooth off the bottom of the seed furrow, a device which significantly improved field emergence of seedlings

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Power and Machinery Division.

S. W. McBirney is senior agricultural engineer, farm power and machinery division (BPISAE), U. S. Department of Agriculture.

ment of new grades or types of beet seed. The seed formerly used consisted of threshed and cleaned seed ranging in size from that which would be retained on an 8/64-in round hole screen up to ¼ in or so in diameter. The normal or unprocessed seeds are actually seed balls with from one up to four or five viable germs or true seeds per ball. Screening into smaller size ranges was the first modification of the seed that was tried. Plantings with 8/64 to 11/64-in and 8/64 to 12/64-in screened whole seed put in by hand and with experimental single-seed planters back in 1936 produced seedling stands which were much more uniform and contained much higher percentages of single seedlings than commercial plantings and started the work on further seed grading which was later followed by other forms of seed processing.

In 1940 reports were received of a successful development in Germany of a seed cracking process by which seed with a high percentage of single-germ segments could be produced. Some of this seed was reported to have been made available to beet growers there, but no further information on it could be obtained. In 1941 a process and equipment was developed in California for producing what we call segmented or sheared seed. Roy Bainer, agricultural engineer, California Agricultural Experiment Station, described this process and equipment in a paper in AGRICULTURAL ENGINEERING for August, 1943, (vol. 24, no. 8).

The subsequent use of segmented seed in suitable single-seed planters was generally found to produce seedling stands which were more uniform and higher in per cent of single seedlings than comparable whole seed plantings. It was found that these seedling stands could be hand-thinned in the usual manner considerably faster than older type plantings and that they were much better suited to mechanized thinning. The result was that the use of segmented seed and single-seed planting came into commercial use very rapidly in 1943 and 1944 and probably would have been even more rapid and complete if a sufficient number of single-seed planters could have been manufactured to meet the demand. As it was about 80 per cent of the United States sugar beet acreage in 1945 was planted with segmented seed used in single-seed planters as far as possible.

RATE OF PLANTING SEGMENTED SEED

The present general commercial practice of sugar beet planting is to use segmented seed at the rate of from 4 to 7 lb per acre depending upon the territory and local conditions and to use this in suitable single-seed planters. Most of the segmented seed is sized from 7 to 10/64 in or 8 to 11/64 in, though there is some 7 to 9/64-in and some 9 to 12/64-in seed. The planters used in most territories are horizontal plate planters with partially or completely machined seed plates with the dimensions and cell sizes mentioned previously. The use of this combination of seed, seeding rates, and planting equipment produces seedling stands which, because of greater uniformity and more single seedlings, are being thinned by hand in the usual manner with a saving of from 20 to 25 per cent in labor as compared to older type plantings. This means a saving of around 4 to 5 man-hours per acre on about 2/3 million acres of sugar beets in the United States, and in some cases it means the saving of many acres of sugar beets which could not be thinned and would not be saved for sugar. The benefits of this type of planting when coupled with mechanized thinning are largely yet to be realized.

There is a trend at present in some areas, particularly in northern California, away from segmented seed and back to small-sized, screened whole seed, chiefly of the 8/64 to 11/64-in size. The seed is used like the segmented seed, however, at reduced seeding rates in single-seed planters. The swing back apparently has been caused by germination difficulties and the production of some abnormal sprouts from the segmented seed resulting from internal injuries during seed shearing. There seems to be a need for some better seed than segmented seed which has all of its advantages and none of its disadvantages.

Recent investigation on sugar beet planting equipment has been along two lines. The first is a continuation of the study of planter characteristics affecting seed distribution and its improvement. The major development along this line has been the improvement in distribution which has been obtained from the use of different seed tubes. If the regular flexible ribbon seed tubes leading from the seed hoppers down to the furrow openers are replaced with smaller diameter, straight or nearly straight, vertical, smooth tubes leading to near the bottom of the opened furrow and dropping seed into the furrow, the uniformity of seed distribution is significantly improved.

In some cases the furrow-opener castings, particularly with disk openers, have cast seed passageways which are curved or have ledges or other shapes which interfere with the straight drop of the seed and thereby decrease the uniformity of distribution. In some cases because of the position of seed tube openings in the opener castings a straight, vertical tube cannot be used as it interferes with the opener disks, or it drops the seed in the V between the disks. In some cases a long tube with a single slight curve backward towards the bottom to clear the disks and drop the seed into the bottom of the opened furrow gives better results than a shorter straight one merely entering the opener casting. However, the shorter straight tube is a considerable improvement over the regular flexible tube if the seed has an unobstructed drop from the lower end of the tube. In some cases it is necessary to move the furrow opener ahead or back somewhat on the planter to get the seed tube in a vertical position. Seed tubes of ½ to ¾ in inside diameter have been most suitable.

WORK DONE ON HEIGHT OF SEED HOPPERS

Considerable experimental work has also been done on height of seed hoppers on conventional planters. The usual change has been to mount the hoppers directly on the disk or runner opener castings and to drive the planting mechanism from a front jackshaft at or near the hinge point of the opener using chains or bevel gears and telescoping shafts. Our experimental results have not shown that this hopper location is better than on the planter frame when telescoping or other suitable, smooth, straight or nearly straight tubes are used. However, there is some preference for this type of planter and one manufacturer has built some planters with seed hoppers mounted directly on the disk furrow openers.

The other line of planter study receiving recent and increasing attention is that of the planter characteristics which affect germination and field emergence of seedlings. On most commercial sugar beet plantings the field emergence of seedlings is only around 30 to 50 per cent of the potential seedlings from the viable seed planted and in many cases it is considerably less. It has become increasingly important that a high per cent of the viable germs produce seedlings in the field when single-seed planting at lower seeding rates of high percentage single-germ seed is used because more dependence is being placed on each viable seed. Field emergence characteristics of planters, as well as of seedbeds, of course, are therefore being investigated.

Our investigational work a few years ago generally showed better emergence with disk furrow openers than with runner-type openers. However, some sections prefer the latter type openers and there is a question as to whether earlier findings with whole seed are as applicable with smaller-sized, segmented seed. Experimental work is now being carried on with different types of furrow openers *(Continued on page 550)*

The Mechanization of Sugar Beet Harvesting

By Claude W. Walz

MEMBER A.S.A.E.

FORTY years ago my father planted his first crop of sugar beets on his farm at Avondale, Colo. It was a new venture for him, and I suppose that is why I remember most of the details so well.

Six acres were planted with a fluted-feed, four-row drill. The cultivating was done with a two-row, one-horse walking cultivator; the beets were pulled with a one-row walking puller. The crop was hauled 6 miles to the station in a wagon box and then shoveled into a gondola car. All the thinning, weeding, and topping was done by Mexican labor. The new mechanization program that is now under way changes the picture for the beet growers.

Segmented seed is planted to eliminate the stooped labor for thinning and weeding. Tractors are in common use for planting, blocking, and cultivating, and there is the beet harvester to harvest, loader to load, and motor truck to haul the beets to modern receiving stations.

After graduating from the school of agriculture at Colorado State College, I followed in my father's footsteps and grew beets for several years. During this time improvements were being made on farm machinery, and at the same time the labor situation was getting tougher and tougher. It seemed to me there must be a way to harvest sugar beets mechanically.

In the summer of 1935 I started to work on a beet harvester, not so much with the idea of building a commercial machine, but that I wanted a machine to harvest my own beets.

Topping the beet was the first problem; then to pick up and place the tops in a windrow, and afterwards to dig the beet free of mud and clods. Topping the beet properly proved to me the need for variable action in the topping unit; in other words, a means of removing more top from a high beet than is taken from a low beet, as sugar beets naturally grow to different heights.

I used a crescent-shaped knife and shoe finder. The shoe finder was later changed to a double set of driven finder wheels. The knife and the finder wheels are supported in position by two pairs of forward arms connected by adjusting links.

I knew that beet tops are valuable feed so they must be saved. After several trials I devised a pickup drum with cammed fingers. This unit picks up the tops directly behind the knife and places them on a conveyor for windrowing.

Digging the beet proved to be the tough job. While I was first working on this problem, several visiting farmers who saw this machine suggested that all I needed was a little gimmick to knock the beets onto a conveyor. I never was quite able to figure out the gimmick; however, after trying chains in various arrangements and then two small pneumatic tires located in a position to catch the beet as it came off the puller, I conceived the idea of the open kicker wheel, which we are now using. The kicker wheels are driven and pass the beets from the puller onto a conveyor.

Finally, in the fall of 1940, I had developed a machine to a point where I was able to harvest my beet crop, and by January 1, 1941, I arranged with the John Deere organization to manufacture the machine. I took a part-time job for three years to help with its production of the machine, and on January 1, 1944, I became head of the experimental department of the John Deere Wagon Works.

During the first three years I helped with the work on the John Deere harvester, I had the opportunity to visit beet growing areas from Winnipeg, Canada, to California, and I became convinced that digging beets was a man-sized job.

Most farm machines are designed to work either on the crop above the ground or in the ground, but a beet harvester has to do both. The tonnage of both tops and beets per acre is well above any other single crop harvested, which makes this job of harvesting sugar beets heavy work. Several approaches to the problem have been made, but there is still work to be done.

In 1941 we built three machines very similar to my original machine and tested them in several beet areas in the West. In 1942 we redesigned and built 15 harvesters and one loader and sold them. We now have some 600 machines in the United States, 21 in England, 1 in Sweden, and 2 in Russia. The machine is a one-row integral unit built to harvest beets in 18, 20, or 22-in rows, working from one side of the field and placing 4 rows of tops in one windrow and 8 rows of beets in a windrow for loading with a beet loader.

In the fall of 1942 when we were caddying after the first 15 machines we had sold, an incident happened that caused me to wonder just how far we had to go to produce a beet harvester. I had built a loop around the end of the beet conveyor and placed a sack around the loop and then cut the bottom out of the sack. This was done with the idea that we might confine the windrow into a narrower A mark for loading. When we arrived at the end of the field with the harvester, a neighbor farmer was there to inspect the job of harvesting beets mechanically. After looking the outfit over he looked into the sack on the conveyor and said, "What, no sugar?"

We felt when we started into this business of harvesting beets mechanically, we were in for some trouble, and we had it. However, we realized we were pioneers in this field, especially after we had some 250 machines out. We also knew to a degree the limitations of the machine, but the beet growers and the beet companies were desperate for help to harvest sugar beets. So our beet harvesters were placed in all the conditions that could be found, which resulted in poor work and broken down machines. However, in fields where the soil is friable, our machine has done well. Some farmers have reported harvesting 75 to 120 acres of beets during the season. Several report 60 tons in one day.

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Power and Machinery Division.

CLAUDE W. WALZ is chief engineer, John Deere Wagon Works of Deere & Co.

The John Deere beet harvester at work

A Mule-Testing Dynamometer

By M. A. Sharp
MEMBER A.S.A.E.

IN connection with an experimental study of types of mules, a machine was needed that would measure the capacity of the mule to pull predetermined loads for any desired length of time. Such a machine must meet the following requirements:

1 It must be strong enough to withstand any load that may be placed on it and sturdy enough so it will not be damaged by hard use or minor accidents.

2 It must be easily transportable so that it can be moved readily.

3 The measuring mechanism must be simple in design, of sturdy construction, easy to operate, and adjustable for small load increments.

4 The machine must maintain a constant predetermined load under all ground conditions and at all speeds.

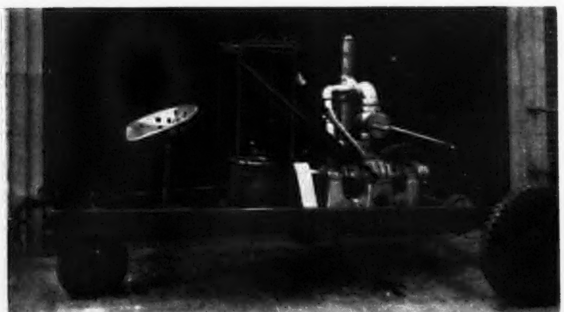
The machine shown in Fig. 1 was designed by agricultural engineers of the University of Tennessee to meet the foregoing conditions. It consists of a gear pump mounted on a frame and connected to an automobile drive shaft by a clutch. The mule pulls on a cable that raises a platform on which weights are placed to give the desired load. The bucket shown was used during calibration and later was replaced by a platform on which cast iron weights of various sizes could be used. Fig. 2 shows the pump in detail. When the clutch is engaged, the automobile drive shaft is connected with the pump drive shaft. The pump is filled with oil, and the circuit is closed by valve B, so the pump gears cannot rotate. When the mule pulls on the cable hard enough to raise the weights, lever C is pulled down, opening valve B so the pump can rotate. As long as the mule pulls hard enough to lift the weights, the vehicle will move forward, because the drive-wheels force the pump to circulate the oil.

The pump is one formerly used in a dynamometer car at Iowa State College and was loaned for experimental use. Valve A, a 2½-in valve, was too large to operate satisfactorily for small increments of load changes. A 1¼-in by-pass valve B was therefore added and is satisfactory. Valve A can be adjusted to let a part of the oil pass it in order to get valve B to operate correctly for small variations in loads.

Load increments are 25 lb at the singletree. The load used for preliminary testing is 25 per cent of the weight of the mule. The mule pulls this load for 30 min and readings are taken to determine respiration and heart action for comparison with similar readings taken before pulling the load. When the dynamometer is to be transported over long distances, the caster wheel is removed and the front end of the frame is attached to a car bumper. It is used for straight pulls on level ground, but the mule may travel in a circle if desired. This machine appears to have all of the desired characteristics and has given satisfactory service. It may be operated under any soil or road conditions and at any ground speed needed for collecting data.

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

M. A. SHARP is head, agricultural engineering department, University of Tennessee.



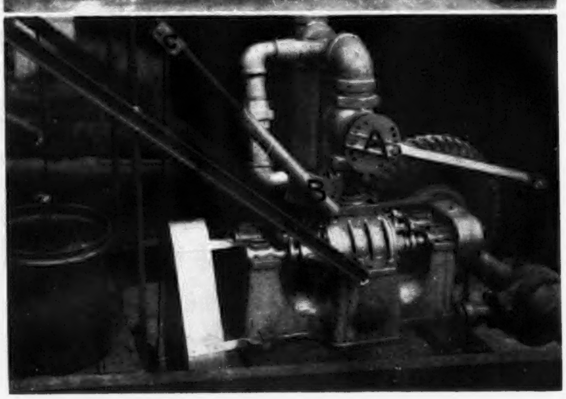


Fig. 1 *(Top)* The mule-testing dynamometer • Fig. 2 *(Bottom)* A closeup view of the dynamometer pump

Sugar Beet Planting Equipment

(Continued from page 548)

and press wheels, different depths of planting and press wheel weights or pressures, modification of the bottom of the furrow, the use of soaked seed or water on the seed, covered row planting, seedbed modification, soil crust eliminators, and other devices to improve the percentage of field emergence obtained. Under what is generally considered reasonably good seedbed conditions, the chief improvement in field emergence last year was obtained by modifying the bottom of the furrow when using the double-disk furrow opener.

The two flat disks of a double-disk furrow opener touch or are closest together at about the ground surface and not at the bottom of the furrow. If the soil stood up perfectly, there would be a sort of W-shaped bottom to the furrow and seed may fall to different depths depending on its size or may contain air spaces below the seed which interfere with germination. Last year's experiments showed that a bar scraper between the disks or a small secondary runner opener between and behind the disks to flatten or smooth off the bottom of the opened furrow gave significantly better field emergence than ordinary planting.

Another significant difference in emergence was obtained by using deep concavity and shallow concavity or flat-beveled-rim press wheels on particularly firm seedbeds. The deep concavity press wheels tended to carry the pressure on their rims and did not cover the seed so thoroughly or firmly and produced poorer field emergence. Under certain poor seedbed conditions, such as dry surfaces, some other devices such as clod pushers or furrowers ahead of the openers or deeper-than-normal planting with part of the soil removed by furrowers immediately behind the opener disks gave satisfactory field stands where normal planting did not.

This year the equipment mentioned above, and particularly devices to modify the bottom of the disk-opened furrow, are being intensively tested. The results and possibly recommendations for improved type equipment will be available later.

A Sugar Beet Combine

By W. E. Urschel

MEMBER A.S.A.E.

THE development of the Scott-Urschel sugar beet harvester has been progressing for a great many years. My experimental work dates back about 33 years when we made a model of a spring-rimmed wheel. Two of these wheels were arranged as a pair to grasp the tops of beets between them and, with the aid of a plow, to pull the beets from the ground.

Experiments on the current type sugar beet combine were begun in 1930. Previous to this we topped beets after they were dug, but no method was provided for gauging the height of the crowns of the beets. Our first machines were horse drawn which did not prove very satisfactory, so we built a self-propelled harvester, powered with a gas engine. This was better, but not much real progress was made until roller bars were used. These showed good results almost from the beginning when used to harvest red beets and carrots for canning factories. Many small red or table beets grow per foot of row and the saving of time by machine harvesting over hand labor interested the canners. The machines were soon in general use and now many farmers tell us they will not raise beets or carrots for the canning factories if they cannot get them harvested by machinery. For a few years the self-propelled harvesters were used, but when tractors with power take-offs came into general use farmers preferred the quick change of unhooking the harvester and doing other farm work with their tractors.

The harvesting of sugar beets was a more difficult job. The crown of the beet had to be cut near the lower leaf scar, removing all streamers and leaves from the beets, leaving them clean for processing.

The harvester, or combine, we have developed, is pulled along the row of beets, with a one-point lifting plow extending about 12 in into the soil below the beets. As this plow lifts the beets, a pair of conveyor chains grasps the beets by their tops and also aids in lifting the beets from the soil. These chains, being held tightly together, convey the beets to the roller bars located to the top rear of the machine. These so-called roller bars are a number of steel bars that revolve in pairs securely holding the beets by their tops and conveying them rearwardly and drawing the crowns of the beets tightly against them so as to gauge the beet to the proper position to be severed by the knives, the knives consisting of a pair of concave disks with serrated edges. As the tops are removed the beets fall onto a short conveyor which carries them to an elevator which in turn elevates them into a truck which is driven beside the harvester. In our present machine the leaves fall to the ground.

With this combine we probably have had about the same amount of trouble as most people have in developing similar machines. Bad weather, unfavorable soil conditions, trash, stones, and weeds require much more time in the experimental work than to develop the machine for ideal working conditions. Where the field is clean, the beets have nice tops, and the soil is mellow, there is no trouble at all, but we have gone through many trying conditions. The machine will now operate in wet, muddy soil or in hard, dry, cloddy soil, or where not too much trash has accumulated. Our experience is that fields must be clean of weeds for good harvesting. If a farmer raises more weeds than beets, he should not complain about the harvester missing some of the beets.

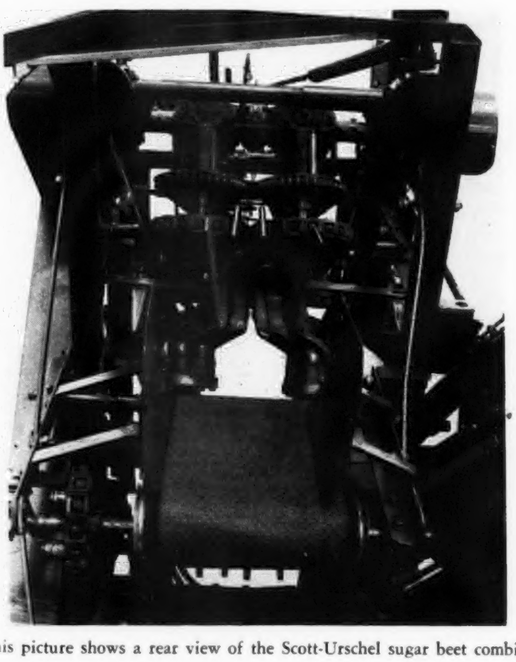
Where tops are heavy, as on muck soil, rolling coulters are necessary, but where they are of average growth, coulters are not needed. The separation of clods from the beets is no problem with this machine. But when beets are left in the wet soil until very late in the season, fine hair roots grow on them, and these hold the dirt. This dirt is difficult to remove. When the machine lifts a beet that has no top on it, the beet remains high enough so it is not covered up with soil and is easily seen, and if enough are left in the field to make it worth while, they may be picked up later by hand. Because we do not top the beets in the ground, the weather or soil conditions do not affect the topping of the beets. In fact, in wet weather we have harvested through pools of water where only the tops of the leaves indicated the row. We have also harvested in snow so deep we could scarcely see the tops, and we did a satisfactory job. We do have the problem of removing the mud from the beets, but probably no more than others, even the hand toppers. In fact, tests this past season showed that as much or more dirt went into the load with hand-topped than with machine-topped beets. In 1944 we had no dirt problem, but this past season was wet and the beets were muddy and gave us much trouble. We are making improvements to take care of these conditions. The 1946 season may be dry again. It must be remembered that when traveling at 3½ miles per hour the machine is handling over 300 beets per minute, and it is only seconds from the time the beet is dug until the top and dirt must be removed. Some growers operate at 4 miles an hour and are thinking of going faster.

Agricultural engineers of the U. S. Department of Agriculture, who assist individuals and corporations to improve sugar beet machinery, have also assisted us. The late E. M. Mervine was the first to lend his help in development of the machine; then S. W. McBirney, and later Lorin Smith.

(Continued on page 553)

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Power and Machinery Division.

W. E. URSCHEL is president, Urschel Laboratories, Inc.



This picture shows a rear view of the Scott-Urschel sugar beet combine

A New Sugar Beet Harvester

By C. E. Guelle
MEMBER A.S.A.E.

THE McCormick-Deering sugar beet harvester, in one continuous operation, tops, lifts, cleans, loads, and transports beets to the edge of the field where they are unloaded into hauling trucks. Once the beets are lifted they never again touch the ground.

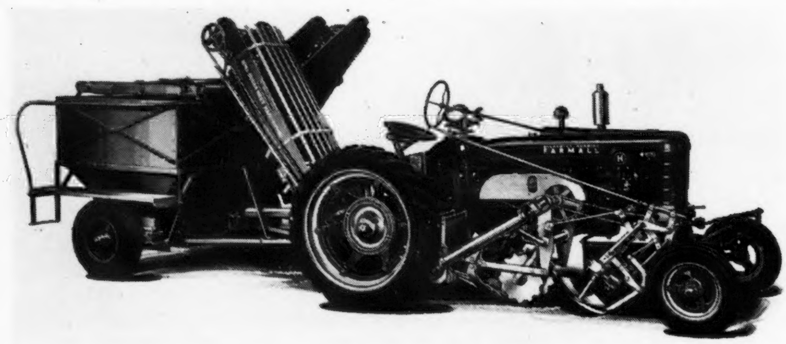
The development of this harvester was started after a thorough study was made of what kind of machine was required and what had already been developed to meet beet growers' requirements. During 1939 and 1940 the existing patents were studied, farmers' homemade efforts were investigated, and research studies being carried on at Davis, Calif., were closely followed. This gave the engineers and sales product men the conception of what a beet harvester should do. One definite idea was arrived at: the machine must operate under unfavorable as well as favorable soil conditions. For two years various principles were tested in a field of beets grown near the factory at Canton, Ill. In 1943 the first machine was built and tested in the fields of the beet country. During 1944 and 1945 improved machines were further tested in the field and in 1945 the equipment was first operated by farmers and not by company field men. The final outcome is the machine that is now in process of being manufactured.

The machine consists of two parts, the harvester units which are mounted on the right-hand side of either the Farmall H, M, or MD tractors and a self-unloading, two-wheel tank cart pulled behind the tractor. The tractors used are equipped with standard attachments which adapt them for beet planting and cultivating, namely, wide-tread front and rear axle and hydraulic "lift-all". In addition, the belt pulley drive and power take-off are required. The harvester units are so mounted that they are in full view of the operator. The harvester units, consisting of the beet topper, the cleaning trough, and the elevator, are driven from a sprocket on the belt pulley drive. The cart unloading elevator is driven from the tractor power take-off.

The operation of the sugar beet harvester can best be described by dividing it into several units which will be referred to as the beet topper, the beet lifters, the cleaning trough, and the elevator which are all mounted on the tractor, and the special pneumatic-tired, two-wheel cart with sorting belt which is hitched behind the tractor.

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Power and Machinery Division.

C. E. GUELLE is product specialist on sugar beet harvesters and seeding and potato machinery, International Harvester Co.



The McCormick-Deering sugar beet harvester

The beet topper unit is mounted close to the right front tractor wheel and consists of an 18-in concave rotating disk which tops the beets, a rotating flinger which removes the tops from the disk and throws them against a canvas from where they drop to the ground in a row. A drag-type finger finder, mounted ahead of the topping disk and connected to it by linkage, slides over the beet tops and accurately gauges the amount of crown removed from each beet. A screw-type regulator, controlled by a crank within easy reach of the operator, makes it possible to change quickly the vertical distance between the finder and topping disk. This makes it easy for the operator to vary the amount of crown removed from the beets. Several adjustments are provided in the linkage of the beet-topping unit to adapt it to either flat or peaked crown beets, to small or large beets, and to correct for dullness of the disk or toughness of the beets.

After the beets are topped they are lifted out of the ground by two puller blades similar to those used on our conventional horsedrawn beet pullers. Mounted directly ahead of the puller blade points are two 16-in notched rolling coulters which cut the trash so that it does not interfere with the puller blades and cleaning of the beets. The action of the coulters also serves to reduce the amount of dirt that is carried to the cleaning trough along with the beets; also, the coulters reduce the size of the clods. All these features aid in cleaning the beets.

From the puller blades the beets are guided into the cleaning trough by extension rods on the puller blades. The cleaning trough is equipped with four shafts on which are mounted kickers similar to those used in many beet dumps. There are seven kickers on the first and third shafts, and eight on the second and fourth shafts, making a total of 30 kickers. Most of the loose dirt and small clods are disposed of by the kickers. The shafts are driven through spur gears and revolve in sealed ball and roller bearings. Three canvases, with rods in the bottom hem, hang vertically over the cleaning trough and keep the beets in constant contact with the aggressive action of the kickers.

The beets are delivered from the cleaning trough to an elevator equipped with a rod-link-type open chain. On the chain are flights of steel fingers that carry the beets to the trailing tank cart. If large clods, trash, or sticky dirt come up with the beets, they can be dropped on to a moving belt on top of the cart. Two men standing on platforms on each side of the cart sort the beets from the clods and trash and drop them into the cart. The clods and trash "go overboard" at the back of the cart. If the beets elevated to the cart are clean, the sorting belt can be tilted up out of the way and the beets dropped directly into the cart. The sorting belt is ground-driven from the left-hand cart wheel. It has been found desirable to drive the sorting belt at approximately one-half the ground speed of the forward travel of the machine. A manually operated jaw clutch has been provided to engage or disengage the sorting belt drive. The cart is unloaded into the hauling truck by an open-link-type potato chain that extends across the bottom of cart. This type chain removes any

remaining loose dirt and small clods that remain with the beets. It is driven from the tractor power take-off. The cart can be unloaded either at the end of the field or, if the field under foot is firm, the truck can be driven to the beet harvester and the cart unloaded while the machine is in operation. It takes 1 to 1½ min to unload the cart tank which has a capacity of 1 to 1½ tons of beets.

The beet harvester units are raised and lowered by the tractor hydraulic power lift. The hydraulic-lift cylinder and the depth-control mechanism are located on the left-hand side of the tractor. The depth control consists of a crank-controlled screw which regulates the depth at which the puller blades operate. The lift is so designed that regardless of the working depth of the beet lifter blades they, together with the topping unit, cleaning trough, and harvester elevator, are always raised to the same height. In other words, it is a constant height lift. The machine is designed for beets planted in 20 or 22-in spaced rows. Under favorable conditions it will harvest 5 or 6 tons of beets an hour in fields producing 20 tons of beets per acre. The approximate weight of the complete harvester with tractor and cart is 7,663 lb when mounted on a Farmall H, 8,722 lb when mounted on a Farmall M, and 9,570 lb when mounted on a Farmall MD.

Here are some of the advantages of this type of sugar beet harvester. It requires only one tractor to harvest the beets and deliver them to the hauling truck. Once they are removed from the ground, they never again touch it, thereby eliminating the possible loss of weight which usually happens if the beets are exposed in rows or piles to the air and sun. The machine is designed for the small or average grower who has from 20 to 60 acres of beets. Growers having large acreages may use several machines.

A small crew is required—a maximum of four men, one on the tractor, two men for sorting, and one for the hauling truck. In favorable soil conditions when the beets can be separated from the dirt easily, only two men are needed for the complete harvest.

Beets can be harvested any time the tractor can be operated in the field. Tests have proved that the machine will work in either wet or dry gumbo soil. Tare and haulback are held to a minimum with this machine. The operator can easily and quickly adjust the topping unit so that it removes the amount of crown desired and then the finger finder accurately raises and lowers the topping disk according to the height the beets are out of the ground. From the time the beets are lifted out of the ground they are continually being cleaned—first, by the aggressive cleaning trough; second, by the open-link elevator; third, by the two men who pick the beets from the clods and trash, and then again by the open-link elevator as the beets are loaded from cart to hauling truck. If, by chance, any beets are dropped on a sorting belt that are not correctly topped or are excessively dirty, the men on the cart can lay them aside and remove the top and dirt by hand while the machine is turning at the end of the row or when the cart is unloaded.

The best topping and lifter units are mounted on the forward part of the tractor so that they are near its front wheels, which makes it easy for the operator to guide the machine down the row because these units respond instantly as the tractor is steered.

Sugar Beet Combine

(Continued from page 551)

The University of California bought one of these machines several years ago; it was used in different sections of the state of California and if labor had been as scarce then as it is today, we believe it would have been used quite extensively in the state. About three years ago Michigan State College bought one of these combines, and the farm crops and agricultural engineering departments have done a great deal of work with mechanical harvesting. They are optimistic and believe that in the near future it will not be necessary to import large numbers of field workers to harvest beets. The Farmers and Manufacturers Beet Sugar Association also bought machines and have placed several with their growers. P. O. Reeves, agricultural supervisor of the Association, said at the conclusion of last season's tests: "We feel that this combine will operate satisfactorily in all soil types and conditions where sugar beets are grown in this area unless field conditions are such that a row-crop tractor cannot operate."

The attitude of growers and processors on the mechanization of the sugar beet industry has changed in the past few years, and this new era of mechanization with segmented seed, blocking, and harvesting should put the sugar beet in a place where farmers will find it their most profitable crop. A truck load of beets harvested by machine does not generally present as nice an appearance as a load topped by hand, and yet the tare and top loss on the machine-harvested beets is often less than hand-topped beets.

For several years this combine has been used successfully by a few farmers who were determined to make it pay them dividends. In 1944, Lee Talladay bought a machine and in two years harvested 196 acres with a saving of $3500 over hand topping. Many other growers made a very substantial saving. These men have kept accurate costs of harvesting by machine and have compared them with the cost of hand topping. Together with the wonderful progress that has been made with segmented seed, thinning, blocking, and other steps to bring the crop up to harvesting, the cost of raising and harvesting a crop of sugar beets has been greatly reduced. Talladay's figures show that the cost of harvesting by machine was less than one-third that of hand labor.

The company building the machine I have discussed has spent considerable time and money on experimental development of both the ground topper and the combine that lifts the beets and then tops them, and after extensive tests we are led to the conclusion that the best results would be accomplished by topping after rather than before lifting, though we realize that in certain localities the ground topper did good work.

Left: This picture shows a large stockpile of hemp maintained by a hemp mill in Wisconsin. In the background is shown a field of shocked hemp • *Right:* This picture shows another method of storing hemp bundles. (Photos by courtesy of International Harvester Co.)

Agricultural Drainage — Problems and Needs

THIS past year the Committee on Drainage decided to prepare a comprehensive statement on the situation, problems and objectives in agricultural drainage. This information is intended to be helpful to agricultural engineers at large, as well as others, in the direction of influencing public thought and action relative to drainage. In the past we have seen drainage projects fail due to incomplete soil surveys, poor planning, inadequate design, faulty construction, and lack of maintenance. The failure to install laterals and field drains contributed to the failure of some organized drainage districts. Many farmers did not utilize the available major outlets. Adequate farm drainage to supplement main outlets needs greater attention and emphasis.

We have seen drainage blamed unjustly by the public for many ills*, as for example, the widespread belief that it was responsible for the prolonged drought and lowered water table in the 1930's. There was a public reaction against nearly all drainage following World War I where criticism should have been directed only against the promotion of unwise and unsound projects. Agricultural engineers can and should help by taking the initiative in guiding public thought and action relating to this subject.

Situation and Problems. Nearly all states having a substantial acreage of wet lands have passed laws governing the formation, organization, financing, and administration of drainage enterprises. The 1940 drainage census shows there are about 40,000 of these drainage enterprises totalling 87,000,000 acres in area. Land drainage has long been recognized as essential to the development of American agriculture and in the improvement of public health. It was recognized early that cooperation of several landowners would be necessary to construct joint drainage works. To facilitate such construction, the first drainage law, of which there is authentic record, was enacted by the Colony of New Jersey in 1772. In forming these enterprises, responsibility for organization, financing, and management rests on the landowners affected. Generally a majority of owners may form a drainage enterprise, levy assessments and taxes, secure rights of way by condemnation if necessary, construct and maintain necessary drainage works and exercise a governmental function in doing these things.

Some Benefits of Drainage. Drainage, in addition to benefiting land immediately affected, promotes the public welfare by improving health conditions, increasing the general tax base, reducing the cost of maintaining highways and railways, and adding to the value of surrounding property and utilities. In addition, there is a public benefit through encouraging proper land use. By drainage, there is an increase in the national income and crop production. Undrained areas now constitute one of the largest sources of undeveloped farm land—one of our last frontiers.

Most drained land is so flat or has such gentle slopes that it is subject to less erosion and deterioration than steep lands. Draining more level lands will permit the retirement of steep land from cultivation. It is therefore of national benefit to encourage the cultivation of drained lands since it promotes soil conservation and proper land use. This benefit has often not been recognized but should be given increasing recognition especially at the national level.

National indirect benefits include the increased values of land, property, and businesses in communities depending upon the produce of drained land, greater freight revenue by railroads, a more stable food supply, and greater construction and employment activity incident to construction and maintenance of drainage enterprises. The latter is a major benefit justifying county, state, and federal participation.

It is of public benefit to encourage only sound projects and avoid losses to landowners and investors through promotion of unsound projects. There are many areas that should be devoted for wildlife, to muskrat farming, or to other uses rather than attempting to drain them under present economic conditions. It is important that agencies engaged in drainage should recognize that the welfare of wildlife is important and has many social, economic, and cultural values important to the public. The effect of drainage proposals on wildlife should be given full consideration.

Principal Areas Drained. The principal areas in which drainage enterprises have developed include: (1) Upland areas typified by the prairies of the midwestern states, (2) bottom lands along large rivers, (3) bottom lands along smaller streams, (4) coastal plains, and (5) irrigated areas. The drainage enterprises in the upland prairie area are chiefly in the midwestern states and include nearly two-thirds of the total lands in organized drainage enterprises. In this area drainage enabled the development during the last century of millions of acres of the richest agricultural lands in the country formerly too wet to cultivate. The generally successful drainage in these states leads to the conclusion that about 90 per cent of drainage enterprises have been reasonably successful and are still operating.

Drainage of bottom lands along large rivers such as the Mississippi, including the lower Mississippi delta, the Missouri, Illinois, Red River of Louisiana, and Red River of the North, have resulted in the development of much fertile land. Drainage has been more costly than in the upland prairies and many drained areas along large rivers have been aided by flood-control operations of the U.S. Army engineers and by state aid. The chief problems in such areas are due to flood waters, to silting of channels, and to inadequate drainage systems.

Attempts to drain many areas of bottom lands along smaller streams have not been successful due to erosion debris filling channels. Much improvement in natural conditions has been secured by selection of higher lands to farm and by installing small channels to remove flood waters more rapidly. Many known failures of drainage districts have occurred in areas such as west Tennessee, northeast Mississippi, and north Georgia.

Attempts to drain on a group basis in the Coastal Plains have been limited in extent. Well-planned and selected projects have succeeded. Much successful drainage has been accomplished in Maryland and Delaware. Most of the projects to drain acid peat soils have failed in whole or part.

Due to the large undeveloped areas in the Coastal Plains this is probably the most important area for the development by drainage of new lands for agriculture. There are vast areas in the Coastal Plains, particularly in Texas, Louisi-

Progress report of the Committee on Drainage (Soil and Water Division), American Society of Agricultural Engineers, for 1945-46. Committee on Drainage: J. G. Sutton (chairman), W. S. Atkinson, A. Carnes, J. E. Christiansen, L. A. Jones, Wm. H. Klingner, E. W. Lehmann, P. W. Manson, Howard Matson, I. D. Mayer, J. T. Olsen, Virgil Overholt, F. F. Shafer, W. W. Weir and E. G. Welch.

*A member of the Committee on Drainage reported as follows: "One of our main objectives must be to educate the average American citizen that farm drainage is one of the most necessary farm practices so essential to successful farming. I am always surprised at the number of students and adults that I meet who still think that drainage is the 'devil' in disguise. These individuals believe that tile will remove the capillary water as well as the gravitational water, that drainage is the direct cause of all our great floods, that drainage hinders normal plant growth during drought periods, and many more falsehoods with which you are so well acquainted."

ana, and all the states bordering the Gulf and Atlantic up to Virginia, which are potential agriculture land. Large streams and rivers cross these plains at intervals and will have to be controlled before many large areas can be drained. Often the cost of works necessary is beyond the ability of the local people to finance. In many areas drainage problems are so complex that extensive preliminary investigations will be required to formulate adequate plans for drainage.

Overirrigation and seepage from canals cause many drainage problems of irrigated lands. Alkali problems are usually associated with drainage problems in the western states, and much land has been unfit for agriculture and often ruined by alkali salts rising to the surface. Control of excessive irrigation water and payments for irrigation water on the basis of the quantity used would aid drainage. Destructive erosion of channels due to excess grade is frequently observed. More attention needs to be paid to providing adequate open and closed drains in conjunction with irrigation systems. Frequently the location and design of necessary drains cannot be predicted in advance of irrigating tracts of land. The advantage of pumping from wells and drying up wet areas and utilizing the water for irrigation is recognized.

Some Reasons for Failures. Best results have not been secured in many drainage enterprises due to low soil fertility, inadequate planning, design, construction, or maintenance. These difficulties have often resulted in crop yields of substantial areas averaging only 50 to 75 per cent of potential yields of the land when well drained. Furthermore, ill effects generally are not evenly distributed throughout a drainage enterprise. Some fields will yield little or no crops and other land in the same drainage enterprise will give almost top yields. So even in a reasonably successful enterprise, drainage, from the viewpoint of one or more landowners, is not always successful.

WHY DRAINAGE ENTERPRISES HAVE FAILED

In attempting to improve conditions in drainage enterprises full recognition should be given to reasons why drainage enterprises have been less successful or have failed. Many landowners failed to take advantage of improved outlets or were slow to install required farm drains necessary to drain the land. Some of the worst failures were due to attempts to drain soils not suitable for farming and which could not support a sound agricultural economy. Poor planning resulted in many drainage enterprises being organized on too limited a scale to undertake the necessary works. One common problem is that many enterprises have inadequate outlets and are not protected from flooding. Often local interests would resort to the organization of several small enterprises along streams where one larger enterprise would have been more efficient. As a result of independent action of the smaller enterprises, there was little or no coordination of design of drainage works. Many enterprises, particularly along hill streams, have failed due to siltation of drainage works. Similar drainage should not be attempted until the silt problem has been brought under control.

Many drainage districts and other drainage enterprises are confronted with the ever-recurring problems of silt control from the watershed area outside the areas of the drainage enterprise. Many of these drained areas are protected by diversion canals which intercept the runoff from the hill area and divert it from the drained area. Such diversions, as well as silt basins and floodways often fill rapidly with silt. The removal of silt and repair of these drainage structures must be done every year or at best every few years and the cost of repairs often exceeds the original costs. Similar problems often occur where hill streams flow directly into drains which serve bottom lands. It is evident that the solution must come with effective control of erosion on the watershed area and along the stream channels which contribute the silt. Future developments and improvements of drainage of river and stream bottoms will need to meet this problem to an increasing extent. Soil-conservation districts in cooperation with drainage districts or enterprises have begun activities to control erosion on watersheds. Plans for this work need to be strengthened.

Poor maintenance is the most serious problem generally confronting drainage enterprises. In a great many states there is no adequate system to raise funds and no organization to maintain community ditches. In many instances, the vegetative growth reduces the capacity of drainage ditches by 50 per cent in one year. Drains deteriorate until crops fail. Many drainage systems are efficient only a small part of the time. Infrequent cleanouts usually do not solve the problem. The resulting inadequate drainage has made it impossible for many landowners to meet the annual drainage costs. Drainage maintenance methods for mowing and grubbing are generally based on hand work, and power equipment needs to be adapted to the job. Drainage enterprises should make available funds annually to cover annual maintenance work including clearing of brush and weeds and light cleanout work. Rehabilitation should be done on the basis of actual need rather than entirely neglected as is generally done. Educational activities are needed to encourage farmers and local officials to maintain public and private drains.

Extent of Drainage Problems. The need for improved drainage is widespread. In the 87,000,000 acres in organized drainage enterprises, there are in humid sections of the country 24,600,000 acres of cultivated and partly cultivated lands, which need better drainage, and 4,300,000 acres of fertile undeveloped lands which can be brought into cultivation through drainage. On this latter land, clearing trees and stumps is usually necessary.

HUGE ACREAGE OF UNDRAINED LANDS

Exclusive of land in organized drainage enterprises, there are in humid sections 98,000,000 acres of wet, swamp, and overflow lands, of which 6,400,000 acres are cultivated or partly cultivated and in need of improved outlet drainage, and 13,600,000 acres of undeveloped fertile lands can be drained at reasonable cost. This leaves 78,000,000 acres of wet and swamp lands which under existing conditions is more suitable to use for wildlife, forestry projects, and other public uses. It is thus estimated that 20,000,000 acres can be drained by community drains at reasonable cost and that the lands are fertile enough to support and maintain an economic agricultural development.

The above estimates of land needing drainage refer only to lands in humid sections of the country. For drainage of irrigated lands, the U. S. Census of Irrigation gives a figure of 3,861,305 acres in irrigation enterprises which have drains installed, and it is estimated that 8,000,000 acres in irrigation enterprises need drainage.

Summarizing drainage needs: 29 million acres in organized drainage enterprises require improved drainage, 20 million acres outside of drainage enterprises can be developed by new community drains, and 8 million acres of irrigated lands need drainage. Thus a total of 57 million acres should have better drainage. Over and above these estimates of land in need of drainage is the land in humid areas in need of farm drains. Land in need of outlet drains generally requires farm drainage. In addition, large areas can be drained by farm drains emptying into natural streams.

There is also a need for the maintenance of natural streams so that they may provide adequate outlets for sur-

face and subsurface farm drains, to prevent increasing damages from overflow and to stabilize stream channels. This is a problem throughout Kentucky and doubtless in many other states. The problem is especially critical in relation to bottom lands along hill or mountain streams where good land is scarce but where stream control is too expensive to handle by the usual type of drainage enterprise.

In securing adequate drainage, greater emphasis is needed on installation of adequate farm drains and laterals to supplement main outlets. There is now great interest on the part of farmers in improved farm drainage. Many recognize that good drainage is required to secure increased crop production. Many farmers have money and are willing to pay for the drains, but owing to shortage of technical help to lay out drains, of contractors and equipment to install them, and of tile and other materials only limited work can be accomplished. The resumption of normal trade will no doubt see these shortages disappear.

Assistance by Soil Conservation Districts. Technical assistance of the U. S. Soil Conservation Service is furnished to soil conservation districts. The extent and amount of assistance furnished by soil conservation districts on farm drainage and on community-drainage enterprises has increased rapidly in recent years. As of April 15, 1946 there were 1,521 soil conservation districts organized by farmers and land-owners including 831,248,090 acres. These districts cover 3,771,681 farms which are more than half the farms in the country. Technical assistance on farm and group drainage is supplied by these districts as a part of their conservation programs. Many soil-conservation districts furnish a complete technical service in connection with drainage work which has never been available to farmers before. In draining lands the soils are examined by soils men to determine their suitability for agricultural use. Crop rotations and soil-building practices are planned by qualified technicians. Engineering plans for drainage are developed under the technical supervision of qualified drainage engineers. These services apply to farm and community-type drainage systems.

COMPETITION WITH PRIVATE PRACTICE AVOIDED

In furnishing engineering services, effort is made by the Soil Conservation Service to avoid competition with engineers in private practice. Where services of private engineers are available and drainage enterprises or individuals can employ them, the engineering service furnished by the Soil Conservation Service are limited to the preparation of a preliminary report, determining the feasibility of the project, and recommending conservation standards. Private engineers are encouraged to handle detailed surveys, plans, supervise construction, and handle all court and contract matters. The Soil Conservation Service encourages private engineers to collaborate in the drainage activities of soil conservation districts.

Farm drainage is one of these conservation practices which has become of increasing importance. In connection with the district program, the Soil Conservation Service installed 299,600 acres of farm drainage in 1945 and 203,000 acres in 1944. The total farm drainage installed to December 31, 1945, was 656,500 acres. Farm drains had been planned for 1,394,000 acres. In the field of community or outlet drains the Service has made surveys, designs, and operations plans for outlet drains serving 572,000 acres during 1945 and 1,299,000 acres as a total accomplishment through December 31, 1945. Construction was completed on jobs serving 205,700 acres in 1945 and the total through December 31, 1945, was 458,300 acres. In connection with community and farm work, drainage enterprises and farmers pay construction costs.

Assistance by Other Agencies. The Field Service Branch of the Production and Marketing Administration (AAA) makes conservation payments to farmers in many states for improving farm drains.

The Corps of Engineers, U. S. Army, has aided the drainage of large areas of land, especially along major rivers, by construction of levees and dredging operations. Many channels have been improved and enlarged in connection with the Army flood-control operations.

The Reconstruction Finance Corporation was authorized in 1933 to make loans to refinance drainage irrigation districts in distress. This agency rendered valuable aid to many drainage enterprises in refunding bonds and in working out practical refinancing plans.

In 1935, 46 CCC camps were assigned to the rehabilitation and reconstruction of existing drainage improvements. These camps benefited lands in drainage enterprises which covered 12,000,000 acres. The Public Works Administration, the Works Program Administration, and projects of other emergency programs benefited many other drainage enterprises during 1933 to 1941. Many states, counties, and townships have appropriated funds from general taxes to aid in drainage work benefiting specific areas.

FEDERAL AND STATE LAND DRAINAGE STUDIES

The U. S. Regional Salinity Laboratory (BPISAE) of the U. S. Department of Agriculture at Riverside, Calif., is interested in drainage of irrigated lands in connection with salinity problems. This laboratory, a research organization, has carried on drainage studies in cooperation with state agricultural experiment stations and local drainage enterprises in several locations in the West, and is currently conducting cooperative investigations in the Coachella Valley of California and the Delta Area of Utah. It has developed, in cooperation with the Irrigation Division of the U. S. Soil Conservation Service, a simple but very satisfactory ground-water piezometer for the measurement of hydraulic heads at various depths below the surface. These piezometers are less expensive, more readily installed, and more sensitive than observation wells of the type generally used for ground-water measurements.

In addition to financial assistance as stated, the state extension services, state agricultural experiment stations, and state universities have studied, consulted, and advised with respect to many important drainage undertakings.

Training Drainage Engineers. The training provided by colleges to prepare engineers for drainage and other conservation work needs study. Many state colleges and universities have adequate courses in hydraulics, hydrology, drainage, flood control, geology, soils, and concrete and structural design to furnish a sound basic training to enable the student to become a well-qualified drainage engineer. A drainage engineer must be well grounded in the fundamentals of soils and agriculture. Some of the courses—for example, soils and those relating to agriculture—are taught in the college of agriculture. Some colleges have excellent basic courses in drainage. Many colleges, however, need to strengthen their agricultural engineering curriculums if they are to provide their graduates with the fundamentals of hydraulics and concrete and structural design needed to plan and design drainage works.

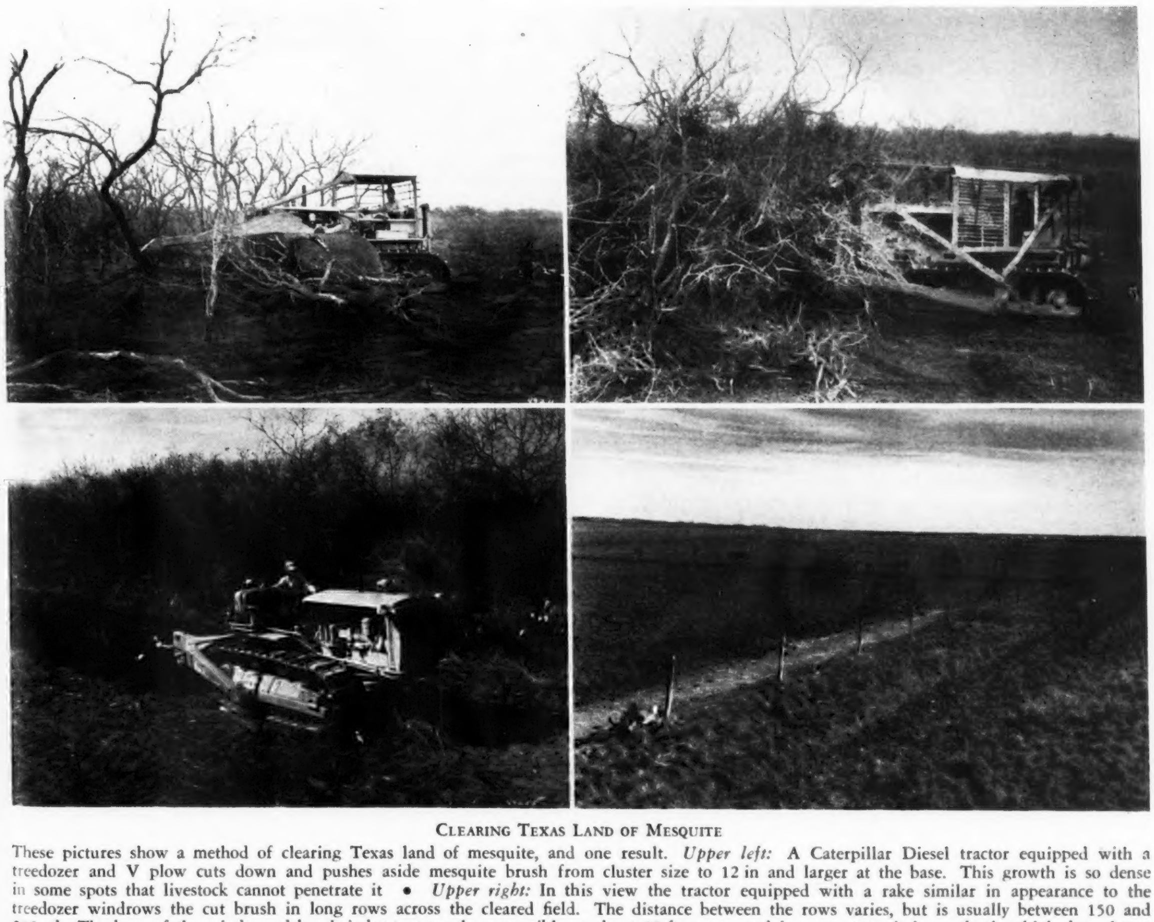
Research in drainage needs to be given more financial support at the national level and to be given more attention by state colleges. The average funds spent for drainage research by the U. S. Department of Agriculture has generally tended to decrease. Funds expended by states on drainage research, in so far as known to the Committee, are not large.

Drainage Objectives and Needs. The Committee on Drainage of the American Society of Agricultural Engineers

makes the following recommendations in order that members of the Society may have the views of the Committee in connection with drainage problems.

The Federal government and states should give aid and encouragement to the wise development of additional drained lands as needed for agricultural production. The need for federal legislation to establish a national policy with respect to drainage and to facilitate orderly rehabilitation and development of the drained lands to insure wise land use in accordance with national requirements should be studied. The nation needs to retire to forest or other uses some 43 million acres of land now cultivated that is mostly too steep to be cultivated and is rapidly eroding away. At the same time, the nation should bring into use millions of acres of land that are flat and subject to little erosion but which should be drained in order to be utilized for agriculture. The less costly projects have been developed already, and the development of future drainage works will often involve expenditures beyond the ability of individuals to pay. Landowners and farmers have been and should continue to be responsible for their farm and community drainage enterprises. They should retain the responsibility for management of construction and maintenance of their works.

Summary of Requirements for Successful Drainage. In undertaking the development of large areas of drained lands under private financing by drainage enterprises, the Committee on Drainage recognizes the following essentials: (1) A preliminary survey and examination to determine the inherent soil fertility and possible productivity of the land if drained and the feasibility and approximate cost of drainage, (2) adequate planning, design, and construction of group drainage works, (3) adequate farm drains and maintenance of soil fertility through conservation principles, including proper rotations and soil amendments, (4) protection of the drainage system against excessive erosion debris, (5) the proper maintenance to permit perpetual use of drains, (6) the need of competent people to handle drainage problems, (7) the improvement and simplification of our state drainage laws, especially with regard to provisions covering maintenance, (8) a well-managed organization to administer the affairs of the group enterprise, (9) outside financial assistance on the control of streams or waters originating chiefly outside the area to be drained is often necessary, and (10) reasonable costs of drainage, promptness in the development of land, and feasibility from an agricultural viewpoint are essential requirements.



CLEARING TEXAS LAND OF MESQUITE

These pictures show a method of clearing Texas land of mesquite, and one result. *Upper left:* A Caterpillar Diesel tractor equipped with a treedozer and V plow cuts down and pushes aside mesquite brush from cluster size to 12 in and larger at the base. This growth is so dense in some spots that livestock cannot penetrate it • *Upper right:* In this view the tractor equipped with a rake similar in appearance to the treedozer windrows the cut brush in long rows across the cleared field. The distance between the rows varies, but is usually between 150 and 200 yd. The base of the windrowed brush is kept as nearly as possible at about 30 ft across, and in some spots it is nearly that high, but always packed as tightly as the tractor can pack it. In rush jobs, fires are started along each side of the windrows. From 12 to 18 hrs after the original fire is set, the second raking job takes place, and this involves pushing all the short, unburned pieces of brush into the fire or moving the whole fire to a larger one nearby • *Lower left:* In this view the tractor is pulling a root plow, plowing 8 ft wide and 12 to 15 in deep. The roots left on the surface after the plow are picked up by hand and then piled and burned • *Lower right:* This view shows cattle grazing on land cleared of mesquite only a few months previously

Revision of State Laws. Better state laws are needed to facilitate drainage work on a sound basis. A study covering the organization, administration, and financing of drainage enterprises is needed to determine more completely the legal and other principles contributing to the success of drainage enterprises. Studies of drainage enterprises in states where they operate successfully and studies to determine reasons why they do not operate well in other states are needed. In addition. immediate efforts are needed in several states to recommend revised drainage legislation. It should be recognized that this is fundamental if the land-owners and farmers are to retain responsibility for the construction and maintenance of drainage improvements and operate drainage enterprises successfully.

Research Needs. The research programs of the U. S. Department of Agriculture and the state agricultural colleges need to be strengthened in drainage. Mention has already been made of the basic need for studies to facilitate the organization, operation, and maintenance of drainage enterprises and revision of state laws in many states. Research agencies are well equipped to undertake such studies.

Research is needed on the development and use of equipment for improved maintenance. This would include adapting power mowers to remove the annual growth of brush and weeds. Further work should be done on an experimental basis with chemicals which will control undesirable species of vegetation. Limited work being done by the Soil Conservation Service in this field offers promise. There is a need to develop and make available light, mobile, and less expensive excavating equipment which can be adapted to small recurring jobs such as the removal of shoals and for handling farm drainage and small laterals involving light yardage. The development of rubber mounted draglines by manufacturers offers promise in this field. The use of dynamite as an aid to maintenance operations needs to be more widely understood and explosives should be made more readily available for use.

NEED TO DETERMINE RUNOFF FROM WATERSHEDS

There is need to determine the runoff from steep or rolling watersheds which should be removed by drains to drain flat valleys adequately. There is also need to determine the proper amounts of runoff to be removed by drains in numerous areas where proper coefficients have not been established. The effects of shallow open drains and tile drains on various soils and crops and their effect on controlling the water table should be studied. There ought to be more work on relationships of drainage to successful crop production, crop rotations, and soil-management practices. The most adequate methods of draining tight soils should be determined including drainage of wet sloping lands. Bedding, terraces, open field drains, and closely spaced tile have been used with varying degrees of success. The limitations of each method and its application to various soils and topographic conditions should be worked out.

Drainage of Irrigated Lands. The drainage of irrigated lands should be given greater attention and the bad effects of alkali on large areas of land should be avoided. In the western states, much land has already been ruined through inadequate drainage and the resulting rise of alkali salts. Some of these lands can be reclaimed through proper drainage and leaching. Often comprehensive investigations for individual areas are necessary to determine whether an area can be successfully drained. The construction of proper drains should be an integral part of the development of an irrigation system. In the past, many systems have been built with inadequate provision for drainage systems, and this has resulted in the loss of much valuable land.

Programs to Aid in Drainage. Programs to aid in the drainage of the 57 million acres needing drainage should be encouraged. Such aid may come from federal, state, or any local source.

A first step in the development of wet lands is an inventory of the areas susceptible to drainage. One of the most valuable resources that the nation has is the large areas of fertile wet land not yet drained. The inventory should be comprehensive enough to determine the location and extent of the areas, the fertility of the soil, approximate cost of drainage, and ownership and other pertinent factors affecting the development of the area for agricultural purposes.

Federal agencies that are now furnishing technical assistance in drainage matters to soil conservation districts should strengthen such services as funds and personnel become available. Drainage enterprises and individuals should be encouraged to employ private engineers to the fullest extent practical. The federal government should not compete with private engineers.

SECURING EQUIPMENT FOR DRAINAGE PURPOSES

Soil conservation districts often rent equipment, such as draglines, tractors, and graders, to drainage enterprises and to farmers. The districts secure this equipment usually by loan or grant from the Soil Conservation Service or by purchase from their own funds. Generally they use their equipment on a non-competitive basis with private contractors. Most soil conservation districts prefer to work through private contractors especially to construct larger jobs. Soil conservation districts usually find that they can use their own equipment most effectively on small jobs, for farm drains, on isolated work, on new and unusual types of work, and on other jobs for which contractors bid high. Such equipment is particularly well adapted to many small group and farm jobs.

In addition to technical assistance, which is now provided in large areas, drainage enterprises often need aid in constructing works to control or enlarge rivers and large streams. The Corps of Engineers of the U. S. Army is authorized by Congress to work on major streams and tributaries. Such work should be encouraged as it will render an aid by furnishing outlets for draining and developing agricultural lands. Such large work is beyond the reach of local agencies.

States, counties, and other governmental subdivisions should give further consideration to the desirability of furnishing financial and other types of assistance in drainage. Many states could well take a more active interest in land drainage. In some states the problem is so involved that state legislation and the development of state agencies and programs will be necessary to solve the drainage problems adequately. An example of work along this line is the action taken in Louisiana to appropriate state funds and authorize a state agency to work and cooperate in drainage activities.

Educational institutions and agencies should recognize the importance of drainage in agriculture and should direct more effort towards solving the drainage problems and securing public recognition and appreciation of the problems and needs of drainage.

Many state colleges need to strengthen their courses of construction in drainage and to give more careful thought to training engineers in conservation subjects including drainage and irrigation. Universities establishing curriculums in agricultural engineering should give special attention to furnishing suitable basic courses in surveying, hydraulics, reinforced concrete, structural design, drainage, irrigation, soils, crops, and farm management to provide engineering graduates with a satisfactory background for conservation work.

A Professional Architectural Service to Farmers

By James L. Strahan
FELLOW A.S.A.E.

FARMERS have never enjoyed the advantages of a professional architectural or engineering service in the same way as have their more fortunately situated urban and industrial counterparts. In earlier, less complicated times, when agriculture was largely on a self-sufficient basis, farmers needs for housing and facilities were not beyond their own abilities and resources. But today there is probably no enterprise more in need of careful professional guidance than is agriculture if it is to yield the most profitable returns. Complicated as many of its specialties are by biological, agronomic, climatic, physical, economic, and engineering factors, a farmer must indeed be a scholar, philosopher, engineer, and mechanic, to say nothing of a keen business man if he is to be successful.

No man can be well equipped in all these fields. There is need, therefore, for specialists. Or perhaps it would be more to the point to say there is need for specialized services. Society in America has recognized these needs. It has set up educational institutions and programs to meet them. For 60 to 70 years the state agricultural colleges and experiment stations have been concentrating on the development of a scientific technique for controlling natural processes and for improving and increasing agricultural production. The results of these endeavors have been the basis, not only for the education of future farmers at schools and colleges, but also for present farmers on the land. Primarily set up as research and teaching mechanisms, agricultural college activities are geared to reach the entire agricultural population—at least potentially.

But education is not the only function required to maintain so complex an industry as agriculture in our democratic state. There are other services and facilities needed by farmers, as they are by most small businesses, which might properly be considered as falling in the realm of private enterprise, at least outside the fields of research and teaching, facilities not adaptable either administratively or fiscally to control and operation by the teaching organizations. To name just a few such services, there is the function of finance or extension of credit, there is the function of insurance or protection of physical assets and health, and there are the strictly professional services in the fields of religion, medicine (including veterinary service), law, engineering, and architecture. Because agriculture is so diverse and made up of so many small businesses which are individually unable to support the necessary professional services in the usual way, some of the above-mentioned functions are carried by government agencies, as for instance credit for low-income farmers, some by cooperatives set up by farmers, as group insurance against the hazards of fire and disease, and some are available only partially, as for instance engineering and architectural service, to the extent that the educational or extension agencies are able to extend them. I am not saying that attempts have not been made to provide the latter, but am saying that the agencies now active in this field are either organically not adapted to do a complete job or are functioning on a strictly commercial basis and therefore subject, rightly or wrongly, to the criticism of being motivated chiefly by considerations other than professional. I should like to go into this a little further.

No one at all conversant with the situation will question the wide variety of housing requirements on the farm for animal, crop, and human protection. It will be freely admitted that successful solution of the many design problems requires an intimate and thorough knowledge of the enterprise to be served by the structure. Only through such understanding can adequate functional requirements be formulated. Because there is no better source from which to acquire this underlying information than the research institutions which are studying the problems and developing improvements, it can be accepted as axiomatic that any organization, whether publicly or privately endowed, which undertakes to provide a service in this field, must arrange in some way to have easy access to the experiment stations findings. To do otherwise would be to prejudice very seriously its chances for wide usefulness.

But to translate fundamental knowledge into concrete structures on the farm calls for more than just an educational program directed at farmers—or at rural builders—or at both. So far as farmers are concerned, it would seem futile to me to attempt to give them sufficient technical education to enable them to do a satisfactory job of modern construction on top of their already full-time job of production. If a building is built, someone *must* perform the essential engineering and contracting function. Decisions must be made on structural detail, on use of materials, on plan arrangements, and on sequence of construction processes. The soundness of these decisions will determine the value of the structure. They can be hit or miss based on snap judgment, or they can be well considered based on forethought and planning. They are more likely to be the former if a farmer, harried by numerous other technical responsibilities, is required also to search out the answers to his own special building questions from a college bulletin, no matter how well the latter may have been prepared.

I have always felt that farmers should contract their major construction jobs. It has seemed logical to me that they would get their money's worth in better construction and in the saving of time. To do this would require some form of contract which would include drawings and specifications. The contract need not be elaborate, but the drawings should be complete; and they should reflect the best thinking available both as to design and as to use and application of materials. But even if a farmer should elect not to contract his work, he must still perform the contractor's function, make a contract with himself, if you like, and he will still need all the help on construction detail and application of materials he can get. A well-developed working plan is still his answer.

Can we not therefore agree at this point that complete and comprehensive working drawings and specifications for farm buildings are desirable; and perhaps go further and admit that they are essential if the best and latest thinking on design and construction are to be realized; and that their value will be greater the closer they approach in quality to an acceptable professional standard? If this is so, then in some way or another it is up to the profession to see that such a service is made available, and this in spite of the reluctance, even the inability, of farmers individually to pay a fee for it commensurate with its value. It seems to me that with the exercise of a little ingenuity and good will, we, the profession, should be able with reasonable dispatch to do this difficult task. As a rule agricultural engineers require more time only when they are called upon to do the impossible.

But before getting into a specific discussion of this problem, may I first interject a thought on materials. For years the traditional material for farm use was lumber. Up until

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Farm Structures Division.

JAMES L. STRAHAN is technical director, Asphalt Roofing Industry Bureau.

quite recently, any man accustomed to working with his hands and having a knack for carpentry could construct and maintain most of the buildings needed on the farm. But other materials began to enter the farm picture shortly before the war, and new applications of some of the older of these were recommended. Asphalt roofing products, asbestos by itself and in combination with portland cement, steel for both framing and covering, aluminum for roofing, various types of insulating materials, gypsum products, plywood and some plastics, glues, lightweight and heavy concrete, brick and tile are among those that are now presented in various advertising mediums, many in competition with lumber, to the farmer's attention. It must be accepted that all of these have legitimate farm application, and it must be recognized that their use involves methods of fabrication peculiar to their own characteristics which must be followed if best results are to be obtained. The question therefore is: Where will the prospective farm builder get proper instructions for the use and application of these many materials? Is there any educational institution or extension agency functioning in the field of farm structures that today feels qualified to (1) cover the whole field of building materials, indicating the most approved method of applying each one, and advising as to the useful life of each under specific circumstances, or (2) make available to its farm constituents working plans for specific buildings in sufficient variety to enable them to choose any desired material or combination of materials?

Perhaps such an extension agency exists. I should like to point out, however, that if it does then (1) it must have acquired more experience with the various materials than the manufacturers themselves who are still working with distributors and applicators to evolve methods that will give constantly better service, and among whom there still remain honest differences of opinion or some questions of technique and (2) it must have more financial resources at its command than manufacturers in general have felt justified in spending individually in preparing typical construction drawings and specifications. Some industrial organizations have spent money individually for this purpose, but unless I am mistaken they have felt the amount to be out of proportion to the promotional value received—the more so as the drawings approached more nearly to an ideal standard of professional excellence and practical usefulness as instruments of construction.

ADEQUATE WORKING PLANS NEEDED

I could be wrong at this point, but I shall nevertheless venture an opinion on the questions I have raised, namely, that (1) generally speaking, extension agencies and college agricultural engineering departments are not now equipped to teach building materials satisfactorily or impartially, nor (2) are they financially able to develop adequate working plans and specifications, plans which will offer their constituents a free and wide choice of materials.

If these answers are correct, then the profession appears to face at least one other major problem in addition to that of providing an individualized architectural service. Some organized effort should be made to place at the disposal of the teaching groups adequate up-to-date information on construction materials with industry's recommendations for their use and application. I am aware that some manufacturing companies and some institutions have cooperated in this way with good results; would it not be desirable to extend such activity to embrace all materials and all institutions? Could not the American Society of Agricultural Engineers, as the professional body, act officially, possibly through some committee activity to bring about a wider base of cooperative contacts between industry and the colleges in this matter of building materials? Speaking as an individual and only for myself, I believe that industry in general would welcome such an opportunity.

To return now to the question of a plan service, it must be apparent that because of limitations of financial resources which could easily prove to be unsurmountable, there is a very good possibility that an individualized service will be proven beyond the scope of an educational organization's activities. It, therefore, becomes the job of the profession at large. For extension services to undertake individual practice with the idea of rendering an adequate professional service to the agricultural industry, to me would be comparable to professional architectural schools and colleges undertaking not only to train architects, but also to practice the profession of architecture in competition with them.

It might be argued that agriculture cannot or will not support a professional service, and that therefore the government must render it free, through outright subsidy. In view of our experience during the past year with a self-sustaining, cooperative, professional organization, I cannot agree with this point of view, at least not until this new organization has been proven incompetent. We think that development toward a subsidized service is fundamentally wrong. We think so because it will probably never be supported by public funds to the extent that it will be able to meet the professional needs of the agricultural industry squarely and adequately.

COMPETENT PROFESSIONAL GROUPS EXIST

Again it may be objected that there exists no body of professional men to take on the job, and therefore it must be considered a public function if it is to be done at all. And again I disagree, for there are several quite competent groups who, if they will cooperate freely, can make real progress. First, there are the agricultural engineers on the teaching, research, and extension staffs of the state institutions. These are the prime source of basic information underlying functional standards. There are the agricultural engineers in the employ of the industries serving agriculture. These are the prime source of information on the characteristics, use, and application of materials and building equipment, and the application of electric power and light facilities. These men are charged with the responsibility of seeing that the use of industrial products in agriculture is extended as widely as possible but only where they are properly adapted and will render good service. There is also a third group whose interest in farm structures, while less technical, is none the less potent. Farm magazines are concerned in any field which is of immediate interest to their subscribers. No one will question the interest of farm people in good building and construction service after the long period of neglect and inability to invest building capital which they have just passed through. As you will see presently, farm magazines have indicated their interest by cooperating in a very substantial manner both financially and editorially, because they felt that our proposals offered good prospects of success in capturing the interest of their farm audiences.

To test out the possibility of securing the necessary cooperation from these three major interests, and to work out methods of procedure, a small group of five industrial and magazine representatives over a year ago decided to undertake a pilot operation to see whether it might be reasonable to expect that working plans of standardized farm buildings could be produced that would combine the essential features of high quality, low cost, and wide distribution. After about eight months active operations, during which the original membership of five increased to twenty-six, we have reached the conclusion that technically and mechanically it is reasonable; that with professional encouragement it offers distinct possibilities for expansion into a very significant and worth-while

contribution to the betterment of farm business and rural living.

Not to go into too great detail, our plan functions about as follows: Cooperation in any specific project involves initial agreement on a definite set of functional requirements, followed by agreement upon a design to meet those requirements. Procedures have been developed for bringing this about before submitting a contract docket to the drafting or production organization. "The Better Farm Buildings Association", functioning through its architectural committee, prepares the design docket and contracts with "Agricultural Associates, Inc.," to prepare the necessary drawings. Members interested in the project associate themselves together in groups for the purpose of reaching agreement on the design and financing the production of the plans. No members in any group will want to finish the design in the same materials, but aside from this one feature, they will all want the same design. We have found by experience that from 60 to 80 per cent of all the lines on a set of drawings are common to the requirements of all members of a group. Therefore, the draftsman first prepares a "base plan" which includes only these common lines. This base plan is then made available to each participant, who thereupon submits to the draftsman, through the architectural committee of the Association, specific instructions for the completion of his drawings. The cost of the base plan, which constitutes the largest single element of the total cost, is divided evenly among all the participants of the group.

Upon completion of the project there results 6 or 7 or 8 complete but differently finished sets of plans of the structure, each distinctive enough to satisfy all the demands of competitive promotion, yet each fundamentally in agreement with good agricultural management practice, and at a cost to each participant of from one-sixth to one-quarter of what it would have been if there had been no cooperative financing.

PRESENT MEMBERSHIP IN THE ASSOCIATION

In order to indicate the breadth of interest already manifest by colleges, magazines, manufacturers, trade associations, and others, a list of the present membership is included as follows: Ruberoid Co., Johns-Manville Co., "Country Gentleman", General Electric Co., Flintkote Co., "Poultry Tribune", "Progressive Farmer", "Successful Farming", Philip Carey Mfg. Co., "Capper's Farmer", "American Poultry Journal", Great Lakes Steel Corp., "Southern Agriculturist", "Hoard's Dairyman", Structural Clay Products Inst., "National County Agent", Farm Structures Inst., Purdue University, Cornell University, "Electricity on the Farm", National Mineral Wool Assn., Producers Council, Asbestos Cement Products Assn., Rutgers University, Starline, Inc., and Agricultural Associates, Inc.

To date we have completed 9 projects for a total of about 45 participants, and several other projects are now in process. They include a dairy stable, two poultry houses, a colony hog house, a small garage and shop, a tobacco and sweet potato curing barn, two airplane hangars, a milk house and several others.

I would not give the impression that this enterprise is now completely successful, working smoothly without troubles or strains. On the contrary, there are still bugs to be worked out of it, both on the technical side and in the administrative and operational phases. In the first place, it takes a lot of the oil of human tolerance to maintain smooth, frictionless working relations in any cooperative undertaking involving contributions from large numbers of people. Because in the last analysis it is people that do the work, not organizations or institutions or groups as such. In a new venture such as this, it takes a long time for more than just a few of us to know how to make our contributions most valuable. Full, effective cooperation from all active members will come about only through experience; and to gain experience takes time.

Furthermore, we who have worked through the initial phases of the project, appreciate that a full measure of success can be realized only if cooperation can be obtained from all elements of the profession. It seems to us that a machine has been devised and set up which is capable of integrating the techniques available from the educational and research institutions, industrial organizations, and the farm press. It has been demonstrated, at least to our satisfaction. But its full potential can be developed only if full cooperation is obtained.

Therefore, in order to avoid policy complications with state and federal institutions, a recent action by our board of governors has extended to any state college, experiment station, or interested branch of the U. S. Department of Agriculture the privileges of associate membership without cost. Thus no publicly appropriated funds are needed to pay dues. It is necessary only that some authorized representative of the institution write a letter yearly to our secretary requesting enrollment as an associate member.

The Association's desire to cooperate is further evidenced by the following quotation from the minutes of its latest meeting: "Be it resolved that the Association instructs its Board of Governors to find mutually satisfactory means to make it possible for state and federal agencies, who are associate members of the Association, to use base plans prepared for the Association, and to use the facilities of the Association's contract vendors on a cost basis."

COORDINATION OF EFFORTS OF ALL NEEDED

Thus the Association, representing wide interests in industry and the press makes possible participation in this cooperative effort on the part of the educational and research groups without cost and offers its production facilities to them on a non-profit basis. This has been done, knowing full well that without cooperation from this quarter maximum possible success cannot be achieved. In fact, the longer we work at this job the more we become convinced that improvement in rural structures will never come easily, but will yield more readily as everyone concerned effectively coordinates his efforts with others aiming at the same objective.

It is hoped that nothing I have said will be construed as minimizing the educational value of any plan service now being operated from the state institutions as an extension activity. There should be no conflict of objective between them and what is here being proposed and sought in the way of institutional cooperation with this privately operated professional enterprise. The two are not mutually exclusive. In fact, active participation by college agricultural engineers in the Association's activities might well very largely take the form of suggesting the use of extension department designs as association projects, thereby increasing many times their range of dissemination and public acceptance, because they will have national distribution backed by the full power of the rural press. Presumably the object of the institutions in promoting plan services is to gain as wide acceptance as possible for design ideas which are thought to be best adapted by those who are in the best position to know about such things.

And in return private enterprise, by means of a coordinated effort, can be of very effective help to the teaching institutions through making available the latest technical information on the many materials which both farmers and students want to know about.

Can we not, within the framework of this American Society of Agricultural Engineers, do a real job of professional coordination for the benefit of the industry we profess to serve? It should be possible.

The Place of the Agricultural Engineer in the Missouri River Development

By Ivan D. Wood
MEMBER A.S.A.E.

ONE of the great river developments of all time is under way in the seven Missouri River basin states. It proposes to add more than 4,000,000 acres of new land and to provide supplemental water to 500,000 acres in addition. On its way to the Gulf of Mexico, the harnessed waters of the Missouri River will operate twenty or more additional power plants, with an installed capacity of 750,000 kw capable of generating more than 3,800,000 kw-hr of firm energy annually.

Vast changes are due to come to agriculture, commerce, transportation, and manufacturing in the Valley. We are concerned here with the impact which these changes will impose upon existing institutions and upon the present agricultural population, and how the agricultural engineer can be of service in helping perfect the vast adjustment which must take place in the years to come. The welfare of the residents of an area 1,300 miles long and 700 miles wide, extending from St. Louis, Missouri, in the southeast to western Montana on the northwest, is influenced by the waters of the Missouri River and its tributaries.

In order that full significance of these changes may be realized, consideration should first be given to the irrigation phase. It is possible that 53,000 new farms may be brought into being with a total increase in rural population of more than 200,000 and an urban increase of 400,000 persons. There will be a great increase in assessed property valuation due to higher land values as water comes to the land or as land is protected from floods.

Nearly two-thirds of the land proposed for irrigation development in the Missouri River basin is located in areas where from 50 to 100 per cent of the area is now in cultivation. This is the eastern one-fourth of the Missouri plains states in the subhumid climatic zone. Production is highly variable due to climatic conditions. One or more years of abundant rainfall may produce bumper crops while dry seasons bring failure and despair. The need and demand for irrigation water will vary with the rainfall from year to year. In the far west, the farmer does not depend upon rain but prepares for the use of irrigation each season because he is sure to need it. Because of this great variation for the need for supplemental water, considerable modification in design of the usual irrigation system and schedule of water delivery will be necessary. New systems of repayment for construction and operation and maintenance costs will also be in order.

It is a matter of record that in the wet years from 1913 to 1918 many irrigation systems in the subhumid zone were abandoned completely. Canals filled with sand and became choked with weeds and willows. Smaller canals and laterals were plowed shut and in some locations drainage ditches took their place. During the great drought of the 1890's, many irrigation systems were built but never used or used but slightly because the year 1896 brought abundant rainfall with correspondingly large crop yields. It is a matter of record, written in the tree rings, however, that many droughts have occurred during the last 400 years in this subhumid zone. In the Nebraska area, thirteen of these periods have lasted 5 years or more, six have lasted 10 years or more, and two of the most serious continued for 20 years or more. Parts of the Missouri basin are areas of great climatic risk, as the above figures testify, and call for new thinking in irrigation design.

In the shift from dry-land farming to irrigation, many new and difficult problems will be encountered. There has been a tendency for farms to grow larger as an attempt has been made to achieve a more efficient dry-land unit operated with mechanical power. The coming of irrigation water will tend to reverse this process and make necessary the modification of farm organization, crop rotations, as well as ownership and tenure arrangements. There is a complete lack of irrigation "know how" in much of the area and much experimentation will be needed before efficient methods are developed. New methods, new machinery, new technical knowledge, new farm organization, and new design. All of these things will result in a resistance to change, and unless a constructive program of research, education, and technical service is forthcoming, it can be expected that development will be a slow and very expensive process.

Sherman Johnson of the USDA Bureau of Agricultural Economics in his presentation to the U. S. Senate committee on irrigation summed up the problems of the Missouri Valley as follows:

> "The problems to be encountered in irrigating a subhumid area, such as the eastern part of the Missouri plains states, have not previously been faced. It is not a shift from desert or semiarid public domain to irrigated farm production. Rather, it is a shift from dry-land production with an expectancy of excellent yields of staple crops in four years out of ten, fair crop yields three years out of ten, and poor yields or crop failures another three years out of ten. This means that the advantage of irrigation to the individual must come either from (1) greater stability of production or (2) higher net income from more intensive production. . . . .
>
> "The conclusion seems inescapable that for irrigation farming to be successful in these subhumid areas, low-cost, labor-saving methods of irrigation must be developed. The methods must be low enough in cost to permit using of water on staple crops—alfalfa, corn, and small grains—also on irrigated pasture. These provide a basis for a staple livestock economy. But water development of this type also necessitates holding construction and maintenance costs at relatively low levels. Specific studies are needed to determine how much farmers can afford to pay for water in the setting of relatively extensive irrigation farming."

Without discussing at length the vast flood control program contemplated in the Missouri Valley Development, or rural electrification which will result when cheap electrical energy becomes available, it appears that there is a challenge to agricultural engineers if the irrigation phase is to be developed rapidly, efficiently, and successfully. The design and construction of large irrigation works in the past has been accomplished with major emphasis placed on permanence and hydraulic excellence of the various structures. Water has been brought successfully to the land and at the farm headgate has been delivered to the farmer who too often was unprepared, from the standpoint of experience, to receive it.

It should not be necessary here to recount all the reasons for the slow development of many irrigation projects in this region in the past or to enumerate the many causes which have contributed to the failure of many settlers. Some of the reasons for slow development and failure of first settlers to stay on the land are as follows:

1 Inadequate land classification both as to soils and topography which resulted in the inclusion in farms of poor soils and

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Soil and Water Division.

IVAN D. WOOD is engineer, division of irrigation, Soil Conservation Service, U. S. Department of Agriculture.

land unsuited to irrigation upon which settlers were expected to make a living and pay operation and maintenance and construction costs

2 Lack of experience on the part of farmers in land preparation and water application resulting in low yields and high costs, as well as water logging of good soils rendering them unfit for cultivation

3 Lack of provision for drainage and disposal of flood water from higher land

4 Failure to maintain high soil fertility necessary for high yields and poor crop selection for irrigated agriculture

5 Poor selection of settlers or a lack of qualified settlers which resulted in some projects getting a poor start and contributed to administrative and financial difficulties later on

6 Lack of an adequate system of financing new settlers during the period when the land was being prepared for irrigation and when the returns from the farm enterprise was not enough to meet all costs.

In 1944, the ten federal reclamation projects in the seven Missouri Valley states reported a total of 859,000 irrigable acres while the land actually irrigated was only 618,000 acres, or 72 per cent of the total. Some projects in 1944 had as much as 92 per cent of the irrigable land under irrigation while others had as little as 46 per cent. On other than federal projects the record is no better. For the United States as a whole, the last census shows a total of 7,500,000 acres for which irrigation works have been constructed but which are not being irrigated for one cause or another. Even in the western states the picture has been one of slow development and low total returns from crop production for many years after the principal works were built.

In the opinion of many experienced observers, the problems which will be encountered in the development of irrigation in the subhumid zone will be more serious than those which have been met in the more arid areas. Therefore, it seems fitting to ask if the new irrigation development in the Missouri Valley plan might not be made more successful by avoiding the mistakes which have been made in the past. Is it not time for the agricultural engineer to step into the picture and try his hand at the wheel?

HOW AG ENGINEERS MAY RENDER SERVICE

Those who have given some serious consideration to the matter of new irrigation developments in the subhumid zones have suggested the following ways in which the agricultural engineer may enter the scene and render notable service:

The Research Field. There is great need for information regarding the type of irrigation system which will succeed in the subhumid zone, where the water may be used for several dry years and then abandoned during periods of abundant rainfall. Is it possible to reduce costs by new designs for the principal works or by a better adaptation of present designs? What types of irrigation district organization can best be used under these new and changing conditions?

Must we wait for twenty years for experience to tell us the proper length of run for irrigation water in rows or borders? Do we know the slope at which erosion occurs on the various soils with various heads of irrigation water? Will we be able to tell new irrigators the proper rate of application and the proper amount of water to apply for maximum crop production for various soils and various climatic conditions?

In the arid areas where irrigation started more than half a century ago, seepage from canals and excess water from overirrigation has claimed thousands of acres of once productive land. Must we wait until thousands of acres of productive land is seeped in the Missouri Valley states, or should the problem be appraised by proper research now and steps be taken to forestall this menace which is sure to come sooner or later?

The interrelationship of irrigation and flood control is not too well understood. Bringing into being a vast flood control program in the Missouri Valley states without a proper appraisal of the effects on water rights and other irrigation phases, could result in no end of trouble. In some cases the underground supply of water upon which the pump irrigator depends is recharged by runoff from surrounding watersheds and any flood control program might upset the balance which nature has provided. It is evident that there is need for much more knowledge than we now possess if the flood control problems of the Missouri basin are to be solved to the best interests of the ranchers of the arid ranges, and the farmers of the irrigated valley and of the delta lands of Mississippi.

The construction of the vast Missouri basin project is under way with many of its problems unanswered as yet. If the failures of the past are to be avoided, a coordinated and much expanded program of research in the irrigation field must soon be undertaken by all the seven state agricultural experiment stations and the federal departments and bureaus involved. The type of research needed goes far beyond the field of general investigations to determine feasibility of any single project. Basic knowledge is lacking in far too many cases.

MOST PROBLEMS INVOLVE AG ENGINEERING

Most of the problems involve agricultural engineering and no one is better fitted by training and experience to give the type of service needed in this research program than agricultural engineers in state and federal employ.

The Educational Field. If the irrigation phase is to develop as rapidly as planned, there will be needed an educational program far different than exists today. For one thing, the irrigation courses as given by the various agricultural engineering departments of state colleges will need general overhauling and expansion, in most cases. Work must be given on modern methods of planning the farm unit, methods of surveying and staking for land leveling, and the use of heavy earth-moving equipment for land development. Work must be given in modern methods of water application, the planning of irrigation projects, and the drainage of irrigated lands, as well as modern irrigation district organization and irrigation law. The agricultural engineer who enters the field of irrigation today will need a knowledge of geology and its relationship to the planning of projects to avoid some of the tragic consequences of seepage which have ruined so much valuable agricultural land in the past.

Certainly the agricultural extension services of the interested states will have a heavy load to bear. Extension engineering divisions should have greatly expanded staffs of capable agricultural engineers trained in the irrigation field who are capable of conducting demonstrations, meetings, and tours, and advising with federal agencies engaged in action programs.

It would appear that the agricultural engineering departments of the state colleges should be the fountain heads from which the leadership in this educational program should flow. Much cooperation will be needed from other departments, it is true, but the agricultural engineers have the opportunity to lead the way. In addition to training agricultural engineering graduates there will need to be comprehensive courses for county extension agents, Smith-Hughes teachers, and others.

In the federal agencies there is need for a greatly expanded in-service training program to make available to employed personnel the results of research or field experience which has been compiled in the past. In this field also the agricultural engineer has an opportunity to take the lead.

In the Field of Action Agencies. It appears at present that the U. S. Army Corps of Engineers, the USDI Bureau of Reclamation, and the USDA Soil Conservation Service will be the principal action agencies engaged in one or more phases of the construction work on irrigation. There is need for the

knowledge and experience of the agricultural engineer in all these agencies.

One cause of the slow development of irrigation projects in the past, and failure of farmers under a system of agriculture, has been the unpreparedness of the farm unit and the farmer to receive water when it came. History has shown, all too often, that dry-land farmers will move to other lands rather than learn a new system and prepare the farm for efficient water distribution. It should be borne in mind that crop production on the irrigated farm and a better living for the farm family is the ultimate aim. All the big dams, canals, and other structures are but the means to an end. In the past it has been common practice to point with pride to the permanence and hydraulic excellence of the principal irrigation works, forgetting that it is the unprepared farmer on the unprepared farm unit who has to pay the bill.

No one can criticize the sound engineering which has made possible our principal irrigation works. What is needed now is the application of the same sound engineering to the design of the farm unit. The agricultural engineer may provide the knowledge which will spell success for the irrigation phase of the Missouri Valley project. It is high time we stop making the same mistakes over and over again. There must be a coordination between the planning of the farm units and planning and construction of the principal works of the irrigation system. Agricultural engineers have an opportunity to show the way.

SERVING FARM UNIT IS ULTIMATE AIM

Since serving the farm unit is the ultimate aim of irrigation works, why not plan the farm units as to land leveling, farm ditches, and structures in advance of the coming of the main canals and laterals, and then coordinate the two. I know personally of many systems in which the main canals, main laterals, and drains were planned and constructed before a single farm unit was even located, let alone surveyed and planned. In other cases, farm units were cut into three or four separate parts by canals, laterals, or drains and the elevation of the water in the main canal designed so low as to serve less than half the acreage on some units through which it passed. In many cases a slight realignment of the main canal or drain would have avoided cutting through hundreds of acres of good farm land and spoiling it with weed-infested borrow pits. Where the lands to be irrigated are in the hands of large owners, or in the public domain, it is often possible to perfect an arrangement of farm units or fields which will avoid cutting them into odd-shaped and isolated tracts, and yet make them easier to level and irrigate.

It is not an uncommon sight to see a large irrigation canal being constructed across fertile fields with wide borrow pits at either side. Then later to see the land being leveled and dirt, which might have gone into the canal banks in the first place, being wasted into the self-same borrow pits. A coordination of design and construction would result in great saving of time, money, and effort. The reverse process is sometimes encountered in the construction of drains. It is common practice to build drains in irrigated areas after the wet spots begin to develop, often after hundreds of acres of good land has been seeped and ruined. A drainage ditch will be constructed through farm units after the land has been leveled, and due to a lack of coordination in design, it will develop that the leveling has been done in a way which renders the drain useless for that particular unit. Had the whole engineering job been properly coordinated, the earth from the drain might have provided the deficiency needed in land leveling and the farm unit so designed that the excess irrigation water could have been emptied into the drain. In well coordinated design and construction the spoil banks of canals and drains might well become roads instead of the unsightly, weed-infested jungles that they now are.

It is a challenge to the agricultural engineer to perfect this coordination of design so badly needed. Certainly no one is better qualified from the standpoint of education and experience to give technical aid at the point where major engineering works and those connected with the farmstead meet.

There is a big job to be done and all available action agencies will be needed to accomplish it. The agricultural engineer can not confine his activities only to the design of the farm unit. He must understand the fundamental principles of project design including the location of canals, laterals, and drains. He must learn to plan the irrigation of whole groups of farm units rather than the farm-by-farm process now in vogue. Land leveling must be considered in its relationship to other units and so must the location of farm drains.

It is generally conceded that the problems to be met in the development of irrigation projects in the subhumid zone will be more complex than those which have been encountered in the arid west, and unless some changes in procedure are made in our methods of approach to the solution of these problems, we can expect the same slow development and recurrence of many of the ills which have attended such ventures in the past.

In the Field of Private Enterprise. There is a growing need for well-trained and experienced agricultural engineers in the irrigation consulting field. Farmers on older projects are realizing the benefits to be gained by well-planned and well-prepared farm units and are willing to pay for the services rendered in such planning. Within the last two years several engineering and land-leveling companies with agricultural engineers at the head have been doing a flourishing business in Missouri Valley states.

CONCLUSION

A vast planning enterprise is being undertaken and the work is under way in the Missouri Valley states. Agricultural engineering and agricultural engineers hold the key which may unlock the door of success. Will we grasp the opportunity by doing these things:

1 Promoting a program of research which will bring to light the facts

2 Participate actively in the campaign of education necessary to acquaint all interested people with those facts

3 Take our rightful place in the action field and supply the services needed to put the engineering of the farm unit on a plane with that of the principal irrigation works

4 Make the place of the agricultural engineer in the consulting field more secure by rendering service of the type which will be needed in communities which will be most affected by the coming of irrigation to the Missouri Valley states?

Tools for Mulch Tillage

FROM the standpoint of soil and moisture conservation and maintenance of yields, I am convinced that stubble mulch farming has a place in Great Plains agriculture and possibly that of other regions. I'm not so sure that much of specialized equipment now being tried will prove more desirable for stubble mulch or crop residue farming than the more ordinary machines now found in common use and which are readily adapted to the various operations being advocated. . . . .

These comments are made, not to decry the efforts of inventive minds, nor belittle the need for new machines and attachments. It is suggested, however, that we first investigate, try out, and adapt, if possible, equipment already available. Let's make capital of what has gone before. In doing so we may save considerable time, effort, materials, and reduce the cash investment needed for equipment to carry on new farming practices.—L. G. Samsel in "Journal of Soil and Water Conservation" for October, 1946.

Respiration in Hay as a Source of Heat for Barn Drying Partially Cured Hay

By J. E. Dawson and R. B. Musgrave

THE barn drying process can be regarded as an expedient method of changing the physical state of the water in partially cured hay from the adsorbed liquid, to the free vapor state. According to the first law of thermodynamics, water always absorbs the same quantity of heat in making this change in state at atmospheric pressure and a given temperature. This quantity of heat, since it is always absorbed, can be considered as that required to evaporate a given mass of water from partially cured hay. A part of this required heat is absorbed from changes in the temperature and kinetic energy of the air blown through the hay. The following preliminary observations cast doubt on the idea that all of the required heat is absorbed from the air stream and suggest respiration occurring within the hay as a significant source of heat for barn drying hay.

PRELIMINARY OBSERVATIONS

1 *Heat Required.* The heat required to evaporate water from partially cured hay is larger than the enthalpy of vaporization of pure water, but the difference between these two quantities is negligible in practical engineering calculations. These facts follow from the first law of thermodynamics, the low heat of wetting of hay, and the small amount of water in partially cured hay having a potential energy appreciably less than that of pure water.

2 *Heat Absorbed From Air Stream.* From data obtained in a barn-drying experiment the amount of heat absorbed by the water evaporated from a batch of partially cured hay was approximated by using the enthalpy of vaporization of water. The amount of heat obtained from the air stream in this experiment was also calculated. The average decrease in air temperature and the average increase in relative humidity were both used for this purpose. The average decrease in temperature indicated 40 per cent from the air stream and the average increase in relative humidity 20 per cent. Neither quantity of heat accounts for the drying of the hay.

3 *Heat Absorbed From Respiration Occurring in Hay.* Recognizing that partially cured hay when confined within a barn tends to heat, it was calculated in 1944 that 60 per cent of the heat absorbed by evaporation of water in the above experiment was produced by respiration occurring within the hay. This calculation was made from the dry matter loss and the heat of combustion of glucose. Dry matter losses in barn-drying hay have been reported by Hodgson et al[2]* and are of the same order of magnitude as those used in the above calculation. When the heat equivalent of the dry matter lost is added to that absorbed from the air stream, the drying of the hay is accounted for within a rather large experimental error.

4 *Published Data Indicate Heat Absorption From Respiration.* Many workers[3,5,6,7,9,10,12] have recognized heat production by hay during barn drying and have recommended intermittent operation of the fan in periods of unfavorable drying conditions to keep the hay cool.

A few workers[2,4,11] have recommended continuous operation of the fan despite supposedly unfavorable drying conditions at night. Jennings[4] reports, "Even at night, when humidity conditions are high, blowing will continue to evaporate moisture from such hay." None of these workers have attributed the rapid rates of drying observed at night to heat produced by respiration of the hay.

Strait[8] presented crude data on a barn-drying cycle from which it can be calculated that as much as 40 per cent of the heat absorbed has come from the hay.

Frudden[1] recognized heat absorption from bacteriological processes and from changes in the kinetic energy of the air passing through the hay. He concluded that both of these sources contributed less than 15 per cent of the heat required.

Because of these conflicting opinions as to the importance of heat production by respiration occurring within partially cured hay during barn drying, two laboratory experiments were performed.

This paper was prepared expressly for AGRICULTURAL ENGINEERING, and is a contribution from the department of agronomy, Cornell University Agricultural Experiment Station.

J. E. DAWSON and R. B. MUSGRAVE are, respectively, assistant professor and associate professor of soil science, New York State College of Agriculture at Cornell University.

*Superscript numbers refer to appended references.

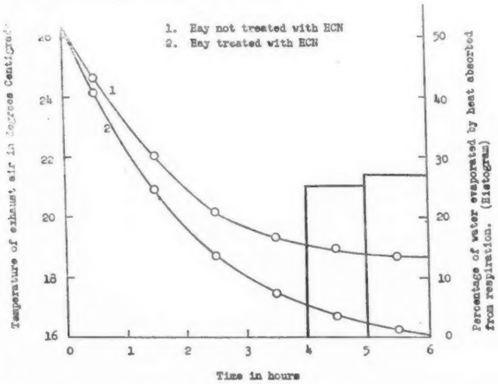


Fig. 1 *Curves:* Temperature of air after passing through either sterile dead hay or living hay as a function of time after initiation of air flow, when the entering air has 0 per cent relative humidity. *Histogram:* Percentage of water evaporated from living hay by heat absorbed from respiration of plant cells at two times after initiation of air flow

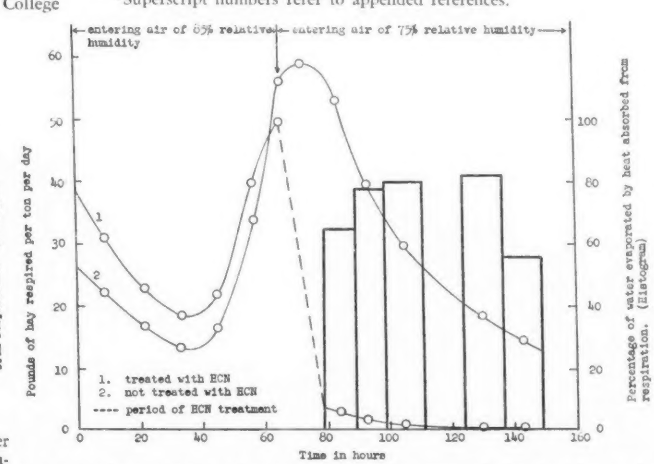


Fig. 2 *Curves:* Rate of loss of dry matter by non-sterile hay and by sterile dead hay as a function of time after initiation of air flow. *Histogram:* Percentage of water evaporated from non-sterile hay by heat absorbed from respiration of microorganisms at five times after initiation of air flow

PROCEDURE AND APPARATUS

Carbon dioxide free air of controlled relative humidity and temperature was metered at the rate recommended by the Tennessee Valley Authority through hay placed in a Dewar flask. The rate of drying was observed by direct weighing of the Dewar flask containing the hay and by weighing the water absorbed from the exhaust air with silica gel followed by magnesium perchlorate. The temperatures of the hay, the entering air, and the exhaust air were measured to 0.1C (degrees Centigrade). Two geometrically identical sets of apparatus were used which contained Dewar flasks of the same heat capacity and heat transfer factors.

When one set of apparatus contained a living, non-sterilized sample of hay and when the other set contained a sample of sterile, dead hay, the temperatures of the sample and of the exhaust air decreased with time until constant values were reached, as the data presented in Fig. 1 show. These data also show that at this time the temperatures of the sterile dead hay and of the exhaust air from this hay were below those of the living hay and the exhaust air from this hay, respectively.

Under these conditions the data in Fig. 1 show the following three facts:

1 The amount of heat absorbed from the air stream and from the surroundings through the walls of the Dewar flask by the water evaporated from the sterile, dead hay is greater than from the living hay since the temperature gradient is greater.

2 The amounts of heat absorbed from the hay and the Dewar flask because of temperature changes were negligible in both cases, when the evaporation measurements were made, because the temperature changes were negligible.

3 Respiration occurring within the living and non-sterilized hay resulted in the production of more heat than was produced within the sterile, dead hay as is shown by the higher temperature when evaporation was measured.

The data in Fig. 2 show that the rate of respiration of hay following treatment with hydrogen cyanide is negligible, and therefore, the production of heat by this process is negligible. Changes in the kinetic energy of the air passing through both hays contributed the same amount of heat to water evaporation since the two sets of apparatus were geometrically identical. Thus, if more water were evaporated from the living hay than from the sterile, dead hay, it must be a result of heat produced within the living hay.

In the following experiments recognition of this fact made possible the calculation of the percentage of the water evaporated from the living or non-sterilized hay because of heat produced by respiration processes from the relation:

$$\text{Per cent} = \left(\frac{Wl - Wd}{Wl}\right) 100$$

where Wl = mass of water evaporated from living hay
Wd = mass of water evaporated from sterile, dead hay.

RESULTS

1 *Heat absorbed from the respiration of living hay, before the development of microorganisms, when using an air stream of zero per cent relative humidity:*

The data in Fig. 1 show that approximately 25 per cent of the water was evaporated by heat absorbed from respiration in the hay due almost entirely to plant cells. This does not mean conversely that about 75 per cent of the heat was absorbed from the air stream. Heat balances calculated for these periods show that more heat was absorbed from the surroundings through the walls and stopper (No. 6 rubber) of the Dewar flask than was absorbed from the air stream. This indicates that the drying rates observed in miniature mows are likely to be much higher than in large mows, at the same temperature and relative humidity, where heat absorption from the surroundings will be minimized by the low surface to volume ratio. Hence, the heat contribution of hay respiration will become much more important for large mows than results obtained in miniature mows will indicate.

This portion of the respiration curve was selected because the rate of respiration at this time is less than at any other time before the hay is dried below 20 per cent water. An air stream of zero per cent relative humidity was selected because the amount of heat absorbed from the air stream and through the walls of the Dewar flask will be as great or greater at this humidity than at any other. Thus, under these conditions, the percentage of the heat absorbed by the evaporated water that will be absorbed from the respiration of the living hay will be a minimum.

2 *Heat absorbed from respiration occurring in hay, after development of microorganisms, when using an air stream of 70 per cent relative humidity:*

The data in Fig. 2 show that from 60 to 80 per cent of the heat absorbed by the evaporated water came from the hay. Under the favorable drying conditions of the preceding experiment, before the development of microorganisms, at least 25 per cent of the heat absorbed in drying the partially cured hay came from respiration of a part of the hay. Under the less favorable drying conditions of this experiment, after the development of microorganisms, more than 60 per cent of the heat required came from respiring a part of the hay. In actual barn-drying operations the drying conditions and respiration rates are likely to approach those classified as less favorable more closely than those classified as favorable.

In this experiment the microorganism population was allowed to develop in the non-sterilized hay so as to obtain the maximum naturally occurring rate of respiration. A relative humidity of 85 per cent was selected for microorganism development because previous experiments had shown that this value was slightly above that necessary for microorganism development in a time of four days. The relative humidity was decreased to 75 per cent for the water evaporation measurements so that the air stream would contribute an amount of heat comparable to that contributed under average conditions.

SUMMARY AND CONCLUSIONS

The percentage of the heat required to evaporate water from partially cured hay, that is produced by respiration occurring within the hay, was measured in the laboratory under two sets of carefully controlled conditions. One set of conditions was selected to give a minimum percentage of the required heat from respiration. The other set of conditions was selected so that respiration would liberate a percentage of the heat required near that usually liberated in barn drying partially cured hay. From these experiments two conclusions were drawn.

First, respiration occurring in hay during barn drying liberates more than 25 per cent of the heat absorbed by water evaporation, when the entering air has a low relative humidity and microorganism development has not occurred.

Second, respiration liberates more than 60 per cent of the heat absorbed by water evaporation, when the entering air has a 75 per cent or higher relative humidity and microorganism development has occurred.

REFERENCES

1 Frudden, C. E. Factors controlling the rate of moisture removed in barn hay-curing systems. AGRICULTURAL ENGINEERING 27:109-111. (1946)

2 Hodgson, R. E.; J. B. Shepherd; L. G. Schoenleber; H. M. Tysdal; and W. H. Hosterman. Progress report on comparing the efficiency of three methods of harvesting and preserving forage crops. AGRICULTURAL ENGINEERING 27:219-222. (1946)

3 Hudson, William E. Studies of barn-dried hay. AGRICULTURAL ENGINEERING 22:170-172. (1941)

4 Jennings, B. A. Mow curing of hay. AGRICULTURAL ENGINEERING 26:104-106. (1945)

5 Koontz, L. L.; Nolan Mitchell; and W. H. Dickerson, Jr. Some results of curing hay in the mow with forced ventilation. AGRICULTURAL ENGINEERING 24:419-420, 422. (1943)

6 McKnight, Ralph E. Operation of hay driers in Virginia. AGRICULTURAL ENGINEERING 27:166, 168. (1946)

7 Ramser, J. H. Mow curing of hay. AGRICULTURAL ENGINEERING 24:418. (1943)

8 Strait, John. Barn curing of hay with heated air. AGRICULTURAL ENGINEERING 25:421-423. (1944)

9 Schaller, John A. A summary of barn hay curing work. AGRICULTURAL ENGINEERING 22:292, 295. (1941)

10 Schaller, John A.; Nolan Mitchell; and W. H. Dickerson, Jr. Barn haydrier. Principles of design, installation, and operation. Tennessee Valley Authority. Agr. Eng. Publ. No. 6. (1945)

11 Turner, C. N. New developments in hay harvesting and curing. AGRICULTURAL ENGINEERING 26:501-503, 510. (1945)

12 Weaver, J. W., Jr. and C. E. Wylie. Drying hay in the barn and testing its feeding value. Tenn. Agr. Exp. Sta. Bul. 170. (1939)

Agricultural Engineering Opportunities in Farm Management Consultation

By George R. Shier

MEMBER A.S.A.E.

IN attempting to present observations relating to the opportunities for professional agricultural engineering service, I find it rather difficult to be specific. There are so many opportunities in sight that I feel like my old dog perhaps did when he no sooner started after one jack rabbit than another would jump up closer at hand.

Because this is a farm structures group I intend my remarks to apply primarily to structures. As you all know, the great need is not only for materials, but for organization of the materials into an efficient unit. By efficiency I have in mind that the structure or the structural equipment will actually solve a major problem and make it possible to turn the farm operator's attention to something else. It is in this matter of structural efficiency that the farm operator, the local dealer, the builder, and the industrial representative are weakest.

The preceding speakers have explained what public institutions and manufacturers are planning to do. Most of these programs are dependent upon the customer and the local dealer for final action. The manufacturer can and often does send his district representative out directly to the customer in response to inquiries stimulated by advertising. The manufacturer's representative often makes the sale, furnishes design information, and takes it back to the dealer. With this sort of service, plus that furnished by the state agricultural extension service, one might logically ask where the opportunity for private practice is to be found.

In AGRICULTURAL ENGINEERING for February, 1946, Carl R. Olson asks how the agricultural engineer located in a rural community would be expected to earn a living. He sees "only a very limited field of opportunity for the professional agricultural engineer unless he has the backing of the state college." Quoting further, he states, "It has been said that there are not enough engineers trained for this field." He then takes the rather dim view that "the field is not attractive under existing conditions; that is, the opportunities are not there."

Continuing further, Mr. Olson outlined a procedure for developing conditions favorable to professional agricultural engineers. There is little doubt that his suggestions are to the point, but it seems doubtful to me if there is any particular urge in our society to develop professional consulting service. When professional service does develop, it is because someone goes out and sells his service, and this is also true in other branches of engineering. Consulting engineers seldom come into being except from inward determination.

If we face the issue squarely, we must recognize that there is a real scarcity of qualified agricultural engineers, especially for structural work, and that by the time most of them have the necessary experience for independent professional work, they are in positions with which they are reasonably content. This does not mean there are few opportunities. On the contrary, it means that opportunities in all fields of agricultural engineering are so numerous that many types of opportunities are undeveloped.

I have in mind a large farm management organization which desires to set up an agricultural engineering department to handle all types of engineering problems, and especially structural and farmstead problems where they believe that good engineering can reduce waste and labor immensely. For the past year they endeavored to locate a man, have offered a good salary with opportunities to expand, but have been unable to find an experienced engineer willing to tackle the job, which of course would require considerable initiative. Instead, most of the prospects have chosen to keep or take jobs where the path was plainly marked and trodden.

If the agricultural engineer wishes to establish a business similar to that of the architect or independent structural engineer, he needs some previous experience such as in agricultural engineering extension, in either public or private employment. If he has the necessary experience, I am convinced that he need only advertise his services to farm owners, particularly in the dairy, corn and truck belts, to get all the jobs he can handle along structural, electrical, drainage, irrigation, and related lines. He must, of course, be competent technically and must enjoy meeting and talking to his prospective customers.

Perhaps the greatest opportunities of all are as engineer to the common, ordinary variety of rural lumber dealer. Having worked rather closely with a number of lumber dealers for several years, I find that many of them are only too happy to turn over building design to an engineer. It gives them much satisfaction to be able to say to their customers that they will call in the agricultural engineer to help get a layout that will be convenient and also sound structurally. It is a service that the competitor perhaps does not have, and it gives the dealer confidence that his materials will give lasting satisfaction.

For the engineer it is desirable business. He works independently and receives a commission or fee from the dealer or customers, according to arrangements made in advance. The dealer sells the service. A handful of live dealers will more than keep one engineer busy.

Such services are not limited to buildings only, but apply to the rapidly increasing list of structural equipment, such as ventilation systems, refrigeration, and conveyors. As of this day, the opportunities are complicated by an immense unbalance in material, labor, and demand, but for the engineer who wishes to be independent, these are not impassable obstacles.

(Continued on page 569)

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Farm Structures Division.

GEORGE R. SHIER is farm structures consulting and sales engineer, Howard S. Sterner Co.

Regional Cooperation in Farm Building Research

By Henry Giese
FELLOW A.S.A.E.

COOPERATION has become the byword for practically all of our great modern developments. Without it, the atom bomb and many other important if less colorful achievements would never have been possible. Agricultural engineers have given evidence of thinking along these lines for many years. Some discussion relative to a cooperative plan service among the land-grant colleges appears as early as 1912. In 1926 and 1927, J. B. Davidson and H. B. Walker, respectively, were called by the U. S. Department of Agriculture to make a national survey of research in mechanical equipment. In 1929 and 1930, I was engaged to make a similar study of research in farm structures. Definite efforts were made to set up a program by means of which the work being carried on throughout the country could be correlated.

Cooperation on the part of workers in the land-grant colleges and the U. S. Department of Agriculture presents several potential advantages. Not the least of these is the better education of those engaged in the cooperative effort. Workers widely scattered and often working alone do not have full opportunity of knowing what is going on elsewhere, and hence are not fully qualified to counsel those in their respective states. The mere getting together at fairly regular intervals presents the possibility of more complete understanding and greater inspiration. By the elimination of unnecessary duplication and the comparing of notes by the several workers, much greater production can be obtained from a given budget. Economy in operation is a goal well worth striving for. It also offers the possibility of so distributing the work that specialized talent and personal interest can be brought to bear more effectively. This again will result in greater versatility and prestige than would be the case if each state were to undertake to cover the complete field.

Housing requirements where they differ at all, do not vary according to the several political boundaries but more nearly along climatic zones. Without cooperation, lack of uniformity among the states has been quite apparent. These differences have mitigated against the prestige and best interests of the land-grant colleges.

The first definite step toward regional cooperation was perhaps the Midwest Farm Building Plan Service. From a small beginning in 1929 with a few of the west north central states, it expanded in area until some fifteen of the midwestern states were included in the cooperative effort. The first regional catalog was published in 1933. The northeastern states followed with a catalog in 1937, the western states in 1939, and the southern in 1940. Now 47 states are cooperating in one or more of the regional services.

The Midwest Plan Service started as a somewhat unofficial activity by the agricultural engineers. Cooperation, although readily and willingly given by the other subject-matter specialists interested in housing, was also on the same basis. All expense over and above the time given by people regularly employed, was paid for through the merchandising of catalogs and material lists and also from the sale of a few magazine articles. The "grub stake" was provided by a loan from R. M. Hughes, then president of Iowa State College.

The value of this pioneering effort, however, is well shown by the fact that in April, 1944, the directors of the agricultural experiment stations in the north central region, plus Arkansas and Oklahoma and the USDA, sent delegates to a regional housing conference in Chicago. Each state was privileged to send as many delegates representing as many departments as he might choose. Some thirty representing practically all of the subject-matter departments interested in rural housing appeared for the three-day conference. The principal topic of discussion at this meeting was the clarification of the over-all problem. Following this meeting, the experiment station director in each state appointed an official representative to serve on a regional committee. Since all of these were men, and all but one were agricultural engineers, two women were added. The USDA Bureau of Plant Industry, Soils and Agricultural Engineering, also the Bureau of Human Nutrition and Home Economics, were invited to appoint representatives on the regional committee.

In July, 1944, a second regional meeting was devoted to committee organization. The thirteen committees deemed necessary for carrying the work forward are as follows: (1) Farm House, (2) Dairy Cattle Housing, (3) Swine Housing, (4) Poultry Housing, (5) Beef Cattle and Sheep Housing, (6) Grain Storage, (7) Forage Crops Storage, (8) Fruit and Vegetable Storage, (9) Machinery Storage and Farm Shop, (10) Farmstead Planning, (11) Economic Relationships, (12) Utilization of Building Materials, and (13) Midwest Plan Service.

It will be seen that one committee deals particularly with the problems of human housing, four with the housing of livestock, three with the storage of crops, and one with miscellaneous storage such as that of machinery. In general, it is intended that the plan service should provide the channel through which all of the other committees will serve the public. A plan well designed and presented offers to the farmer an effective translation of the best current information. Committee chairmen were elected from the membership of the regional committee on the basis of interest and qualification for the particular assignment, and also to place on no person the responsibility for more than one chairmanship. Nominations were made to the committee chairmen for committee personnel but responsibility for final selection was placed entirely in the hands of the chairmen. The total membership on the 13 committees is 98 and, with the elimination of duplications, represents 75 persons. W. V. Lambert, then associate director of the Purdue Agricultural Experiment Station, was appointed administrative adviser, but was succeeded by F. R. Immer, associate director of the Minnesota Station when Dr. Lambert became assistant administrator of the USDA Agricultural Research Administration. Following the untimely death of Dr. Immer, Dr. Edmund Secrest, director of the Ohio Agricultural Experiment Station, was appointed by the directors in the north central region to serve the committee as administrative adviser. The regional committee has held meetings at least once each year since its organization. A steering committee of four, elected by the regional committee, meets at more frequent intervals. Local committees have been appointed in each of the cooperating states, usually from the agricultural extension service staff as well as the experiment station staff.

The regional committee chose as its first goal the preparation and publication of a complete series of bulletins covering rural housing problems. These publications, representing the best current thinking, will be issued by the state in which the chairman is located, but will bear the designation of regional

---

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at St. Louis, Mo., June, 1946, as a contribution of the Farm Structures Division.

HENRY GIESE is professor of agricultural engineering, Iowa State College.

publications and as such will be the official documents of all of the cooperating states. The procedure for the preparation of these manuscripts is as follows: Each committee, comprising members well distributed over the area, prepares an outline of manuscripts which it feels necessary to serve the purpose. After review and approval by the regional committee, the manuscripts are prepared and five copies sent to each cooperating state for review and criticism by the local committees. Suggestions for revision are routed back to the committee chairmen over the desk of the station director in each state. After revision and a second similar review, the manuscript is prepared by the committee for publication. One manuscript, on beef cattle housing, is just off the press. Those on the farm house, dairy cattle housing, and economic relationships have been reviewed once. The others are in various stages of preparation.

Extensive plans are being made for the revision and reissue of the Midwest Plan Service. Joint financial support by the several states and the USDA is assured. It is planned to revise all plans thoroughly and to add others as needed. Each subject matter committee is responsible for the selection of plans for the buildings and equipment relating to its field. It is believed that both the plans and the catalog material will be definitely superior to that which has been offered in the past.

The second general activity of the committee deals with research. While it is not expected that definite assignments will be made to each of the several states involved, it is believed that the trend will be in that direction by general agreement. As a preliminary in this direction, each subcommittee has reviewed the field and listed the problems which should be investigated. At an early date it is to be expected that the lists will be revised and rearranged in order of approximate importance.

Farm Management Consultation

(Continued from page 567)

Basically, the opportunities open to the engineer are enormous and the technical advances in agriculture are multiplying them constantly. At present the potential customers do not demand professional service because they do not know it can be obtained. Furthermore, it is a field that seems to require experience as well as schooling, and above all it requires that the engineer work for the fun of the job and the pleasure of helping friendly people solve their problems. The customer is almost without exception a constructive community leader, a man with knowledge and experience who sets the technical pace for his neighbors. Such men are stimulating to work with, and every job well done sells the next one.

Some in our society have held that public agencies, utilities, and industry are doing the job and that the independent engineer cannot live against this competition, but it seems to me that such views are unduly pessimistic.

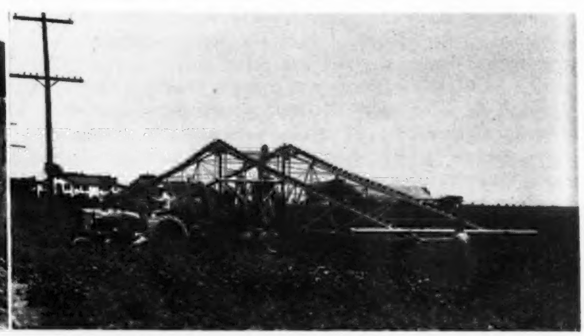
Personally, I welcome the activities of these organizations and find them to be very helpful. They always have more requests than they can properly attend to and are only too willing to share the technical work with the independent engineer. In fact, their pioneer work in research and promotion is creating opportunities for independent business and service much faster than individuals are appearing to perform the needed jobs. There is a great deal to be done and too few engineers in the mood to do it.

Dr. Paul W. Chapman has painted a forceful picture of the situation as he sees it (AGRICULTURAL ENGINEERING for August, 1946). I too feel that one of our greatest needs is for constructive, technical development in our rural communities. The opportunities are there, but undeveloped. I would like to see farm-reared, college-trained agricultural engineers returning from school to their homes to develop these opportunities, but the trend is not now in evidence, because these young men do not see the opportunities. Their view is obscured by a cloud of salaried opportunities dangling from every limb along the well-trodden paths. In short, there is no economic incentive to develop professional service.

In my own case, I had reasons other than economic. There is fun in pioneering, and I fell for the lure of the fun and I have been astonished to find that people enjoy paying for my fun.

To summarize the opportunities in the farm structures field:

1 Cooperate with rural lumber dealers
2 Furnish professional design services to farm owners
3 Furnish consultation to farm owners and managers on remodeling and labor-saving plans
4 Furnish special field services to industry
5 In doing these things, stick to those jobs that require engineering practice. Let someone else do the jobs that can be done by farm management, statisticians, mechanics, and ordinary varieties of salesmen
6 The city farmer is not as good a customer as owner-operators
7 Although there is not at present economic pressure to force agricultural engineers into independent professional employment, it is financially feasible to develop professional services in the farm structures field
8 Certain types of sales engineering go hand in hand with consulting practice.



Left: Sprinkler irrigation raised potato production 50 per cent for H. R. Talmadge, a Long Island, New York, potato grower. In the foreground is a Farmall tractor equipped with two-row cultivator and special vine lifter in front • *Right:* To move light, portable irrigation pipe from one set of potato rows to another, to be irrigated, C. C. Young, another Long Island potato grower uses the conveyor shown here. It consists of two endless chains mounted on a tubular frame, with 3x6-in boards fastened at right angles to the chain at 1-ft intervals. The frame sets on a trailer pulled by the Farmall tractor shown. As the conveyor moves down the field, workers on one side disconnect the lengths of pipe and place them on the conveyor, which carries them 70 ft to the other side where they are removed and reconnected

A State Conservation Research Program

By T. W. Edminster
JUNIOR MEMBER A.S.A.E.

THE nine-year-old Virginia soil and water conservation research program has two major objectives. The first, and definitely the most important, is the task of planning, establishing, maintaining, and completing a job of soil and water research that gives the results needed for an active and successful field program of soil conservation. The second is the almost equally important job of preparing and putting this information into the hands of those who need it.

No matter how carefully planned or executed a research program may be, if the results obtained are allowed to be hidden in the files or in progress reports of limited distribution, then the research program might just as well have been forgotten and the taxpayers' money put to other uses.

It is with this philosophy in mind that the cooperative soil and water conservation research program of the Virginia Agricultural Experiment Station, U. S. Soil Conservation Service, and Tennessee Valley Authority has been conducted. The first four or five years were spent mainly in getting the "goods". In 1936 the Virginia station, under the direction of J. H. Lillard, established fifteen 1/50-acre control plots on five slopes and utilized a three-year rotation. The plots have given excellent information on the effects of slope, crop, and rainfall characteristics upon the actual soil and water losses in Virginia — invaluable information in any conservation education program, in addition to its basic use in solving technical design problems.

In 1937, cooperative studies were developed with the TVA on pasture runoff in southwest Virginia. This project included both plot and watershed installations. Much valuable information regarding effects of phosphate and liming on water losses has been published as an outcome of these studies. The watershed data are now being used in the preparation of a hydrologic report for the Ridges and Valleys Region of Virginia.

In March, 1938, the Soil Conservation Service joined forces with the Virginia station and the TVA. Two small agricultural watersheds were established in Blacksburg and three near Chatham, in the Piedmont area of Virginia. Interesting hydrologic data have been obtained from these installations, and as the length of these records increases they are becoming more and more valuable. The Blacksburg data are forming the basis of the Ridges and Valleys report.

In 1939, contour furrow experiments were originated, and were revised in 1941 into their present form. The year 1943 saw the beginning of an extensive stubble mulch research program. These studies have brought out the many difficult problems involved in adapting this system of farming to the semi-humid, perennial grass areas of Virginia — problems requiring complete modification of previous conceptions of stubble mulching. This past fall (1945) a project was established to study permeabilities of critical drainage soil types and to correlate these results through existing and new drainage systems. This project is state-wide in its application.

These projects are going concerns, and each contributes to the job of defeating soil erosion. There are other projects planned to meet further the field needs — an orchard erosion control project, irrigation studies, farm pond studies, and additional work on agronomic problems. This work is waiting only for additional funds and personnel to get them under way.

So much for the "tools" with which to get research results. Let us look into the use and adaptation of this information.

Soil and water conservation research data are used by a number of groups in the state — the Soil Conservation Service, the extension service, vocational agriculture teachers, the college of agriculture staff, the Farm Security Administration, and others.

Probably the most extensive use of the material is made by the Soil Conservation Service. Consequently, it is of the utmost importance that they be kept thoroughly informed of each and every new development. It has become the policy at the Virginia station for the state and the assistant state soil conservationists (SCS) to meet frequently with the research staff. During these meetings the field problems are discussed, and when possible, station data are applied to their solution. When the Virginia research program fails to meet the problem, every effort is made to find results from other stations that will. As certain problems become more and more critical, the state administrator, with the assistance of regional and zone technicians, aids the research staff in outlining a research work plan to meet the need. With this joint operations-research basis of planning it is possible to get a sounder and more complete project — a project that is designed specifically to meet the needs of the field. Of course, care is taken to keep such a plan broad enough to prevent too limited an application of the results.

This mutual understanding of research-operations problems is further strengthened by the attendance of research personnel at many of the field meetings. Joint discussions at these meetings often bring out new slants on field questions. Whenever requested by field workers, the research staff makes every effort to visit special problem areas and sites. These field consultations aid both the operations and the research men in becoming aware and more understanding of each others needs.

During the initial project days emphasis was placed on the technical reporting of the results. These technical papers and bulletins were valuable in so far as serving to coordinate the Virginia results with results at other stations. But their value ended at that point. Because of their complex technical presentation, they are of little value to the average field worker. The busy technician needs and expects to find this material clearly and concisely summarized in an easy-reading form. Involved tables, graphs, and descriptions are just thrown aside.

To overcome this gap between the field worker and the research information, we have started a policy of preparing a popular version of each technical publication made. The first of these field-use bulletins appeared in the form of "Losing Farms by the Truckload"—a pictorial presentation of the highly technical bulletin of the Virginia Agricultural Experiment Station, entitled "Effects of Slope, Character of Soil, Rainfall, and Cropping Treatments on Erosion Losses from Dunmore Silt Loam".

Operations men frequently are stationed in areas where there are not adequate library facilities to enable them to keep up with outside reading in soil and water conservation. Since nearly all of the current magazines, books, and releases pass through the research office, it was decided that that office could be of great assistance in keeping the Virginia soil conservation service technicians informed on sources of current information. After joint discussions it was planned to put out an annotated mimeographed bibliography once each quarter. By making notes as to the (Continued on opposite page)

This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Birmingham, Ala., February, 1946. It is a contribution of the soil and water conservation research project of the agricultural engineering department, Virginia Agricultural Experiment Station, and the Soil Conservation Service (USDA) cooperating.

T. W. EDMINSTER is project supervisor (hydrologic research), Soil Conservation Service, U. S. Department of Agriculture.

A State Ground Water Code

By Rodney Ryker

ALTHOUGH the Ground Water Code of the State of Washington has been in effect only sixteen months, it appears to be meeting with the general approval of those interested in ground water supply.

In order to protect investments in connection with the use of water, whether from surface or ground water sources, water users desire to obtain water right titles. This can best be accomplished by means of a water code. Furthermore, such an act tends to conserve the supply.

The act provides for the appropriation of ground waters in excess of 5000 gal per day. It also provides a means of recording rights to ground water in excess of 5000 gal per day, which were established by use before the act became effective, June 7, 1945, by filing declarations of ground water claims, upon which water right certificates may be issued. However, such rights may be included in adjudication proceedings to determine their extent and priority as against other ground or surface water rights. All rights are subject to regulatory control by the state supervisor of hydraulics.

In some localities of the state, the growing demand and need for ground water, particularly for irrigation purposes, will exceed the supply and, without regulatory control of its withdrawal and use, competition would result to such an extent that the greatest benefits from the use of water would not be obtained. The number of electric power lines being constructed in many rural communities, together with cheap power rates which are adding to the practicability of obtaining ground water, is making the situation more acute.

However, we are aware that complete regulation of the withdrawal and use of water from ground water sources cannot be accomplished nor can complete effectiveness of the act be reached until more information is obtained as to the extent, depth, and location of the supply. Considerable preliminary work has been done toward this end by the ground water branch of the U. S. Geological Survey in cooperation with the state, and plans have been made to greatly expand this work so that it may be completed at the earliest possible date.

Ground water records are needed, not only to administer the act properly, but to show that many subterranean streams exist. Otherwise our courts may hold that all ground waters are percolating waters and that their use comes under the doctrine that such waters belong to the land owner, subject to a reasonable use, as against the rights of owners of other overlying lands. However, the courts have indicated that, where the appropriation and use of flowing ground waters are involved, they will be treated the same as appropriations from surface streams.

We believe that the provision of the Washington Ground Water Code, exempting from administrative control withdrawals of 5000 gal per day or less for the common needs of a household, which includes water for irrigation of lawns and family gardens, and for stock use, is a good feature of the act in that it does not subject the water user to the costs and difficulties of filing applications for permits to appropriate for withdrawals of less than that quantity, or of filing declarations of ground water claims for rights for that quantity existing before the act became effective.

The following table shows the number of applications for permits to appropriate ground water filed from June 7, 1945, to October 1, 1946, according to the purpose for which the water is to be used, and the number of permits and final water right certificates issued thereunder; also the number of declarations of ground water claims filed during that time and the number of certificates of water right issued:

Purpose	Number of Applications	
Irrigation		
West of Cascade Mountains	127	(for 5,266 acres)
East of Cascade Mountains	151	(for 10,934 acres)
Industrial use	34	
Municipal supply	52	
Miscellaneous uses	19	
Total	383	
Total number of permits issued	254	
Total number of certificates issued	23	

* * * *

Irrigation*	156	(for 6,348 acres)
Industrial use	65	
Municipal supply	66	
Miscellaneous uses	23	
Total	310	
Total certificates issued	200	

*The number of declarations of claim to ground water rights for irrigation purposes on the east and west sides of the Cascades and the acreage covered are in about the same proportion as the number of applications filed on either side of the mountains.

Well drillers throughout the state have for the most part given full cooperation to this office in administering the code.

This report was prepared expressly for AGRICULTURAL ENGINEERING.

RODNEY RYKER is supervisor of hydraulics, department of conservation and development, State of Washington.

A State Conservation Research Program

(Continued from opposite page)

contents and adaptability of the material at the time of the initial reading it takes but a few hours to prepare the final list. The material is also classified into two major groups — material for background reading and material for immediate field and educational use.

All operations men have a standing invitation to visit and go over the research project.

The entire agricultural engineering department and various other experiment station departments have worked closely with operations in carrying on training courses. In the fall of 1943 the project staff instructed over 70 work-unit men in basic engineering note keeping and instrument use. This course was given in three 3-day periods, with 20 to 25 men in each class. During the past year the agronomy department gave a refresher course in agronomic practices to two groups over three-day periods. The groups were divided according to locality so that each of the two groups had problems in common.

Additional research-operations seminars are being planned for future training periods — refresher courses for returning servicemen; educational programs for new conservation aids; and instruction in the use of new research demonstrational material.

These cooperative activities with the Soil Conservation Service are equally important and valuable with the state extension service, the vocational-agriculture classes and with the resident faculty of the college of agriculture. All of these men are in constant contact with farmers and groups in an educational capacity. It is of the utmost importance, therefore, that they be kept thoroughly informed on all developments in soil and water conservation research. It would be disastrous if the extension men, charged with the duty of carrying on the educational program for the entire soil conservation program, were not thoroughly informed on the latest trends in that field.

The development of this interactivity on the part of Soil Conservation Service research and the state educational forces is

now a going concern. It has been slow in starting, but this caution has led to the formation of a sounder program.

At the beginning of this paper it was pointed out that there were two highly important phases of the conservation research program: (1) obtaining research results and (2) the job of cooperative studying, planning, and extending these results through joint research-field user effort. The story of the development of the Virginia program has been used to illustrate the steps taken, the methods used, and some of the results being obtained. The program is by no means complete or perfect, but it has presented a concerted effort at a unified approach to the whole conservation problem. As it now exists, the program is limited to a state basis; however, many additional returns would come from a similar program of interstate action where a group of states have mutual problems. The double-barreled state program could then become a program unlimited by state lines.

Plans of Subcommittee on Water-Plant-Soil Relationships

By C. S. SLATER, Chairman

THE organization of the A.S.A.E. Committee on Agricultural Hydrology as outlined by its chairman, D. B. Krimgold, includes the Subcommittee on Water-Plant-Soil Relationships (see AGRICULTURAL ENGINEERING for January, 1945, page 36). The general field of the Subcommittee is outlined in the published statement, and plans for the immediate program have been developed by the chairmen of the Committee and Subcommittee and concurred in by Dr. R. E. Moore, who is serving as collaborator. A pertinent communication from Dr. F. J. Veihmeyer is gratefully acknowledged.

Water-plant-soil relationships encompass broad and diverse fields of investigation. The subjects of potential and actual evapo-transpiration, the physics of soil moisture, and irrigation and drainage requirements outline in a general way the field of this subcommittee. The water capacity of soils in relation to supply, the use of soil water by plants in relation to maximum economy of crop production, the adaptation of cultural practices toward increased efficiency in moisture use and mitigation of the hazards either of drought or drowning, the varietal adaptation of crops to soil moisture conditions, and the measurement of soil moisture are more specific phases that are the concern of the Subcommittee. Soil amendments that affect soil-water-plant relationships may be considered as a field for possible further investigation. I. M. Felber and V. R. Gardner (Mich. Agric. Expt. Sta. Bul. 189) have shown that a hydrophyllic colloid markedly affects resistance of some plants to drought.

Numerous organizations — private, state, and federal — are conducting investigations that relate to the general field of this subcommittee, and an extensive literature covers many specific phases. It is believed that the first effort of the Subcommittee should be directed toward a condensation (for engineers and hydrologists) of the proved information that relates most closely to agricultural engineering and hydrology. To this end synoptic papers will be accepted — and are indeed solicited — from experts in specific fields. It is inferred that these papers, in delineating the boundaries of established information, will also indicate its deficiencies.

The second effort of the Subcommittee will be directed toward symposia to cover, one at a time, specific phases of water-plant-soil relationships. These in turn will furnish a basis for comment and discussion in the pages of AGRICULTURAL ENGINEERING or at national or sectional meetings of the American Society of Agricultural Engineers, and, we hope, stimulate increasingly effective applications and research.

Safeguarding Machinery to Reduce Farm Accidents

TO THE EDITOR:

I was interested in the criticism you quoted in the A.S.A.E. Newsletter for October for not more rapidly putting into effect practicable designs for safeguarding machinery to reduce farm accidents, and I would like to add a few comments of my own.

We all appreciate the fact that, if something could be done to save one arm or leg in the next ten years, the expense involved would be well worth while. I believe the problem of safety on farm machinery should be analyzed to determine just where the responsibilities fall. There is an old proverb which states: "He who will not hear, must feel." I hope this statement won't be taken too literally, but I do think machine operators should heed the safety precautions more than they have in the past.

I have done considerable traveling in servicing farm machinery. I have seen power take-off shields practically every place, except where they should be. I have seen people make adjustments on machines while they were running. I have heard customers complain that tractors would not travel fast enough in high gear. These are just a few of the things which multiply the safety problems of farm machinery.

I am not saying that manufacturers should not design more safety into their machines, for anything done in this respect would be helpful. However, I believe that, with the increasing amount of mechanization on farms, operators must definitely become safety-minded. Programs should be launched to bring out this fact more forcibly. The farm equipment dealers should have more than the usual means of promoting this.

I believe the National Safety Council should be able to recommend added means of emphasizing safety devices to operators over and above that which is already being used.

In summation, I would recommend that the manufacturers not be burdened with all the responsibility. The operators must in some way be made more conscious of the things that are already employed for their protection and that, to be effective, they must be in their place and adjusting procedure for implements must be followed. If, in some manner, we could help to instigate a program of intensive safety education, starting possibly with films, etc., exhibited to 4-H and F.F.A. groups, and following on through to operators themselves, I am sure the manufacturers would be willing to cooperate as they have in the past.

H. E. BERNS

* * * *

TO THE EDITOR:

While I agree in part with the quotation under the heading "Designing for Real Safety," in the A.S.A.E. Newsletter for October, I must take exception to the statement that "about all we have had is some high-powered ideas as to standardizing the kind of safety notices to be posted on machines."

One very important contribution has been the standardization of the power take-off, including the safety shield. This has saved numerous arms and legs where the shields have been kept in place. An excellent indicator is the large number of legs and lives lost each year because operators fail to keep the shields in place. One cannot fairly blame the designer or manufacturer when the operator fails to utilize a safety device.

During the past week I have noted newspaper reports of four farm accidents in Iowa — two fatalities and two injuries. Both fatalities occurred in tractor upsets, one where a World War II veteran was filling holes in the barnyard. Certainly these two deaths must be attributed to faulty operation practices rather than to design or manufacture.

The two injuries consisted of loss of a leg and an arm. The leg was lost when clothing caught in an unshielded power take-off shaft. The arm was lost when cleaning clogged husker rolls while the machine was in operation. Both are the result of faulty operation.

Cooperation within the A.S.A.E. and the farm equipment industry has saved many injuries and lives in the past, and it is the objective of the Committee on Safety of A.S.A.E. to foster not only design principles that provide safer equipment, but also the more important, long-time job of developing and teaching safe operating principles and practices.

At one of the farm safety sessions of the National Safety Congress held recently, Dr. H. H. Young of the Mayo Clinic stated that there has not been a corn picker accident come to the clinic for attention from the areas in which he has appeared on programs devoted to farm accident prevention. The clinic's investigation of the cause of accidents they have treated showed they were due primarily to faulty operation practices.

V. S. PETERSON

"Professional" and "Service" Ag Engineers

I HAVE been a member of A.S.A.E. just a little over a year. During that time I have read several articles and letters in AGRICULTURAL ENGINEERING containing references to "professional" standing. It seems to me that agricultural engineering includes many types of work—*all* necessary but not all in white-collar class. Those that harp on professional standing would seem to be believing in the age-old, mistaken idea that to work with one's hands is degrading.

For every white-shirted *professional* ag engineer we need dozens of men who can lay out irrigation ditches, service farm equipment, promote rural electric lines, help the farmer to remodel his henhouse and his water system—in fact, to *do* all the work the *professional* man thinks of.

We are so busy thinking how our colleges can train the *professional* ag engineer that we forget about all of these other men who are needed to do the service work for the feed companies, the utilities, the farm machinery companies, etc., and to be the rural builders that are needed in every community. Let's have a companion curriculum to the one for the professional ag engineer that is designed to train these *service* ag engineers. If our future farmers and our many related agricultural workers need college courses designed for them, then certainly do our service ag engineers need the same grade of instruction.

Incidentally, more of these service engineers would certainly not lessen the need for our worried *professional* ag engineers.

Extension agricultural engineer
University of Maine

EDWARD W. FOSS

It's a matter of PRINCIPLE...

Holding fruit on the tree for normal ripening is now practical by spraying apples and pears with new chemicals called "hormone sprays." Taking advantage of the principle of growth regulation through hormone action, growers use these new sprays to slow up the breaking away of the fruit stem from the spur or twig to which it is attached. As a result, the fruit hangs on for normal ripening—quality is improved—size and yield increased—cull losses reduced—and picking costs lowered.

Providing flexible power for orchard work are high compression gasoline tractors which take advantage of this principle: Each additional pound per square inch of compression pressure before ignition gives approximately four additional pounds per square inch of pressure on the power stroke after ignition. As a result, high compression tractors give more power plus all the other advantages of clean, dependable gasoline operation.

Sound principles pay off on the farm

Use of hormone sprays to control pre-harvest dropping of fruit increased rapidly following their introduction in 1940. Fruit growers, constantly interested in all new means to improve production and cut costs, were also quick to adopt high compression gasoline tractors following their introduction about 10 years ago. In orchards, as elsewhere, these tractors have gained in popularity because they combine dependable year-round performance with clean, easy operation.

That is why *farmers today buy more high compression tractors than any other type.*

***As a matter of principle*– RECOMMEND HIGH COMPRESSION TRACTORS**

ETHYL CORPORATION, *Agricultural Division,* Chrysler Building, New York 17, N. Y.
Manufacturer of antiknock fluid used by oil companies to improve gasoline.

NEWS SECTION

Southeast Section Program

THE Southeast Section of the American Society of Agricultural Engineers has arranged a most attractive program for its meeting at Biloxi, Miss., January 14 to 16, in conjunction with the annual convention of the Association of Southern Agricultural Workers.

The opening session on the forenoon of January 14 includes three interesting subjects. T. G. Walters, Georgia supervisor of vocational agriculture, will discuss the relationship of agricultural engineering to vo-ag training. Four manufacturers—John T. Phillips of Lilliston Mfg. Co.; Edward F. Neild, Jr., of J. B. Beaird Co.; J. M. Wagner of Turner Mfg .Co., and E. C. Gibson of Southern Iron and Equipment Co. will present the efforts of southern manufacturers to produce equipment for agriculture of the South. A. W. Turner, chief of agricultural engineering research, USDA, will talk on federal aid in research.

Two concurrent programs will be presented during the afternoon of the same day. One of the programs, featuring subjects on soil and water conservation and power and machinery, will include a paper on farm machinery problems relating to soil and water conservation practices by R. L. Lester of the U. S. Soil Conservation Service; two papers on farm ponds, one by J. L. McKitrick, University of Kentucky, and the other by T. W. Edminster, SCS; three papers on mulch culture, one by G. B. Nutt of Clemson College and T. C. Peele of SCS, another by R. C. Hines, Jr., of Virginia Polytechnic Institute, and a third by L. F. Reed of the USDA Tillage Machinery Laboratory, and a final paper by F. E. Edwards of Mississippi State College on equipment for application of anhydrous ammonia to the soil.

The other concurrent program, on farm electrification and structures, will include a paper on hybrid seed corn drying by J. W. Weaver, of North Carolina Agricultural Experiment Station, one on small seed and cereal grain drying by J. W. Simons, agricultural engineer, USDA, another on round storage structures by H. A. Arnold of the Tennessee Agricultural Experiment Station, one by F. M. Hunter of the Mississippi Agricultural Extension Service on 4-H farm electrification clubs, and a final paper on electric house heating by Dr. E. N. Kemler, Southern Research Institute.

The annual dinner of the Southeast Section will be held at 6:30 p.m., January 14, at the Buena Vista Hotel. The speaker for the occasion will be Dr. Mark L. Nichols, national president of A.S.A.E., and assistant chief (in charge of research), U. S. Soil Conservation Service.

The second day of the meeting, January 15, will open with two concurrent programs, one of which will be a joint session of the Section with the Southern Section of the American Society of Horticultural Science. The program for this session will include the following papers: New developments in sweet potato planting machinery by J. K. Park, agricultural engineer, USDA; new developments in sweet potato harvesting machinery by W. D. Poole, Louisiana State University; recent developments in dusting and spraying machinery by R. V. Wood, Niagara Sprayer and Chemical Company; chemical control of weeds by E. M. Hildebrand, A. & M. College of Texas; orchard layouts for soil and water conservation by J. T. McAlister, SCS, and packaging of fruits and vegetables by A. L. Stahl, Florida Agricultural Experiment Station.

The other concurrent program is being arranged jointly by the Southeast Section and the agronomy section of A.S.A.W. and will include papers on cotton production by E. C. Westbrook, Georgia Agricultural Extension Service; cotton production following lespedeza serecia by S. V. Stacy, Georgia Experiment Station; fiber spinning tests for cotton quality by J. M. Cook, USDA Cotton Testing Laboratory; improving cotton for mechanical production and fiber quality by E. C. Ewing, Delta and Pine Land Co.; Mississippi seed and lint certification program by J. W. Oakley, Mississippi Seed Improvement Assn.; cotton defoliation by T. W. Gull, Delta (Miss.) Experiment Station; mechanical cotton harvesting by E. B. Williamson, Delta Station, and flame cultivation by W. E. Meek, also of the Delta Station.

On the afternoon of the second day two concurrent programs will be presented, one of which, featuring soil and water conservation and farm machinery subjects, will include a paper on an extension farm machinery program by J. B. Wilson of the Alabama Extension Service, a symposium on combines, and a third paper on an SCS district informational program by C. W. Chapman, SCS.

The other concurrent program for this period has been arranged jointly by the Southeast Section of A.S.A.E. and the home economics section of A.S.A.W. and will include papers on farm homes with concrete by Hugh Roberts, Portland Cement Assn.; new developments in household equipment by Elmer R. Daniel, TVA; methods of lowering construction costs by P. B. Potter, Virginia Polytechnic Institute; and practical heating and ventilating of farm homes by Randall Carpenter, a consulting engineer of Starkville, Miss.

A.S.A.E. Meetings Calendar

December 16 to 18 — FALL MEETING, Stevens Hotel, Chicago.

December 19 and 20 — 3rd Barn Hay-Curing Conference, Stevens Hotel, Chicago.

January 15 to 17 — Southeast Section, Buena Vista Hotel, Biloxi, Miss.

February 7 and 8 — Pacific Coast Section, Davis, Calif.

The forenoon of January 16 will be the last half day of the program of the Southeast Section and will open with a short business session. This will be followed by a special Latin-American program which will include a talk by Jose Garcia Inerarity of Cuba on agriculture in Latin America, and another by J. Duarte of the Dominican Republic on agriculture in that country. J. S. Reeves of Goslin-Birmingham Mfg. Co. will discuss processing equipment for ramie fiber, and it is expected to have a speaker on fueling the farm with liquified petroleum gases. The session will close with a motion picture on Latin-American agriculture and a display of manufactured products presented by Senor Garcia.

Michigan Members Petition for Section

MEETING at Dearborn, Michigan, November 2, 1946, members of the American Society of Agricultural Engineers from Michigan and from Toledo, Ohio, petitioned the Council of the Society authorization to organize the "Michigan Area Section." Approximately 50 members were present.

D. A. Milligan acted as chairman of the meeting. He called on Frank J. Zink and A. W. Farrall, chairman and past-chairman, respectively, of the Chicago Section to report on its organization and activities. In the following discussion, H. J. Gallagher pointed out that an active section could foster closer relationship between agricultural engineers in public service and commercial work, which would help to bring agricultural engineering to a fuller development in the region. Mr. Milligan and others pointed to the particular value of section activities in rounding out the development of the younger agricultural engineers.

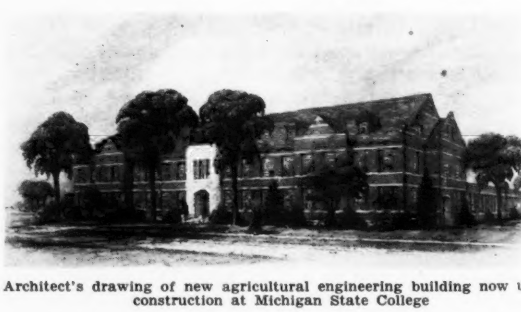
Active interest shown by members from Toledo led to a decision that the section, if authorized, should include and serve members located close to the borders of Michigan and not included in other organized sections.

The following temporary officers were elected: Chairman, Harold E. Pinches; vice-chairmen, Dan M. Guy, Frank W. Peikert, and Herman J. Gallagher; and secretary-treasurer, Weldon O. Murphy. These officers are to constitute the temporary executive committee of the group.

New A-E Building at Michigan State College

A NEW agricultural engineering building at Michigan State College is now nearer realization, with installation of the footings and start of actual construction. This building which is to be 210 ft square will have two stories with basement and attic in the front and a single story in the rear. It will have 60,000 sq ft of floor space, and will include an auditorium with a seating capacity of 300. Construction will be of steel reinforced concrete, with brick and stone on the outside. Laboratory facilities will be available for all of the normal agricultural engineering activities, and a research laboratory of approximately 6500 sq ft will be available, in addition to a number of individual research laboratories. It is expected that the building will be completed during the fall of 1947.

(News continued on page 576)



Architect's drawing of new agricultural engineering building now under construction at Michigan State College

Extra Stamina Reaps Savings

Here's a one-man, self-propelled combine reaping two harvests.

Single-engine powered, it harvests any threshable crop in one operation, and in doing the job, it reaps savings... *substantial savings*... in fuel, time and labor.

Moreover ... to assure long, low-cost performance ... the maker of this machine, International Harvester Company, specifies vital gears in Nickel alloy steels of the 8600 series containing Nickel, chromium and molybdenum.

In the carburizing grades, these triple alloy steels containing Nickel permit heat treatment with minimum distortion. They make possible hard, uniformly wear-resistant surfaces backed by strong, tough cores. Gears made from these steels have *extra* stamina to withstand repeated shock loads, high tooth pressures and other severe stresses.

Be sure you specify Nickel alloy steels for your hard jobs.

EMBLEM OF SERVICE

INCO Nickel

TRADE MARK

Over the years, International Nickel has accumulated a fund of useful information on the selection, fabrication, treatment and performance of alloys containing Nickel. This information and data are yours for the asking. Write for "List A" of available publications.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

NEWS SECTION

(Continued from page 574)

Roberts Heads New Northwest Section

JUNE ROBERTS, agricultural engineer in charge of the rural electrification (C.R.E.A.) project, State College of Washington, was elected first chairman of the Pacific Northwest Section of the American Society of Agricultural Engineers at its organization meeting at Portland, Ore., October 30 and November 1. Three vice-chairmen of the new section were elected as follows: Karl O. Kohler, Jr., regional engineer (Region 9), Soil Conservation Service, USDA; T. Karl Dimmitt, farm service director, Puget Sound Power and Light Co., and M. G. Huber, extension agricultural engineer, Oregon State College. Walter R. Friberg, agricultural engineer, University of Idaho, was elected secretary-treasurer of the Section. A nominating committee was also elected, consisting of M. R. Lewis (chairman), C. J. Hurd, and J. E. Badley.

Technical sections of the meeting occupied the forenoon and afternoon periods of October 31 and November 1, with four concurrent round tables on rural electrification, soil and water conservation, power and machinery, and farm buildings during the evening of October 31. The meeting closed with a dinner on the evening of November 1 with C. O. Bunnell, manager of the Pacific Power and Light Company, acting as toastmaster. The speaker for the occasion was Marshal Dana, editorial page editor of the Oregon Journal.

During the business session of the Section it was voted to confirm a previous informal invitation of the group in the area to the Council to hold the 1948 annual meeting of the Society in the Northwest, and it was specifically recommended that the meeting be held at the Multonomah Hotel in Portland the week beginning June 20 of that year. Clyde Walker, who rendered yoeman service as temporary chairman of the Section prior to its organization meeting, and also as local arrangements chairman for that meeting, was by popular demand asked to assume the task of looking after local arrangements if the Society's annual meeting is held at Portland in 1948.

Georgia Section Meeting

THE Georgia Section of the American Society of Agricultural Engineers held a very interesting meeting at Athens on November 2, according to information furnished by Section Secretary W. J. Liddell.

The Section chairman, H. S. Glenn, manager, Colquitt County Rural Electric Co., presided at the technical session held during the forenoon, the program of which featured the following papers: "Sweet Potato Storage," by J. W. Simons, agricultural engineer cooperatively employed by the USDA and the University of Georgia; "Performance of the 1946 Mechanical Cotton Harvester" by E. N. Anthony, operator of large farms in Ocenee County, Ga.; "Factors to be Considered in Irrigation System Design" by E. H. Davis, irrigation specialist of the Georgia Agricultural Extension Service, and "A Rural Electrification Program," by L. M. Shadgett, a district manager of the Georgia Power Co. The session was concluded with a business meeting of the Section.

The meeting adjourned at noon to permit those in attendance to attend the Georgia-Alabama football game in the afternoon.

McDade Heads Pennsylvania Section

OFFICERS of the Pennsylvania State Section of the American Society of Agricultural Engineers elected at a meeting at Pennsylvania State College, October 30 and 31, are C. A. McDade, chairman; E. K. Bonner, Jr., vice-chairman, and R. E. Patterson, secretary-treasurer.

Fifty-one members and guests registered for the meeting. Fifteen technical papers were presented during the two days. Subjects included dehydration by refrigeration, time studies on farms, storage design, farm refrigeration, electric motor controls, painting, poultry housing, electric chicken pickers, tillage methods, blower-type orchard sprayers, garden tractors, barn hay curing, germicidal radiation, and fish pond design.

The annual dinner of the Section was held at the Nittany Lion Inn on the evening of October 30, with Lyman E. Jackson, dean of the school of agriculture at the College, as toastmaster. Speaker of the evening was Dr. George Haller, assistant dean of the school of chemistry and physics, Pennsylvania State College.

Personals of A.S.A.E. Members

F. F. Alexander, for several years vice-president in charge of sales of the Electric Wheel Company, was elected recently at a meeting of the board of directors of the Company to the position of president and treasurer.

James S. Boyd recently accepted appointment as assistant professor of agricultural engineering at Michigan State College. He was previously a member of the agricultural engineering staff at South Dakota State College.

R. Barry Cecil has resigned as a farm production specialist for the General Electric Supply Corporation at Nashville, to enter into business for himself at Gallatin, Tenn., under the name of Cecil's Sales and Service. He will specialize in the sale of General Electric appliances to the farm trade.

(Continued on page 578)

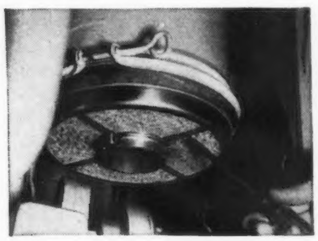
1 REMOVE OIL CUP. On tractors, daily servicing of the oil cup is usually necessary. On other engines, service when level of dirt in bottom of cup is about one-half inch, or when oil is too thick to circulate freely *Do not remove oil cup when engine is running.*

Air cleaners protect the performance and prolong the life of engines by keeping abrasive dust and dirt from moving parts. Without this protection engines would quickly wear out.

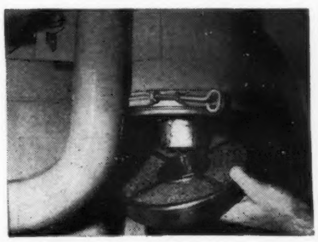
However, regular, careful servicing of the air cleaner is essential to keep it operating properly. You serve both yourself and your customer by stressing the importance of proper air cleaner care whenever you sell a power farm machine. Your customer will benefit because the machine will run better—longer. You benefit too, since the customer will be better satisfied with the machine you sold him.

Ordinarily, only the simple steps outlined here are required. They take little time, but they return generous dividends.

2 CLEAN OUT SLUDGE. Pour out old oil and wipe out cup. Refill with fresh oil up to oil level bead, no higher. Use oil no heavier than that used in crankcase.



3 CHECK LOWER SCREEN. Ordinarily, little attention is required here, but it is good practice to inspect screen and remove any leaves, chaff or straw.



4 REMOVE AND WASH. Some Donaldson Air Cleaners have a removable lower section. If dirty, remove and wash in gasoline. Then dry

5 CLEAN CENTER TUBE. Inspect center tube several times a season for dirt accumulation. Remove by ramming cloth through tube.

NOTE: Once a season, remove entire air cleaner element and wash in gasoline or kerosene. Check hose and hose clamp connections periodically. Air cleaner efficiency is directly dependent upon air tight connections

Reprints of this advertisement are available to manufacturers, distributors and dealers. Write us on your business letterhead.

DONALDSON Oil-Washed AIR CLEANERS

SALES ENGINEERS: Chicago, Detroit, Cleveland

DONALDSON CO. INC.
666 PELHAM BLVD. ST. PAUL 4, MINN.

DONALDSON COMPANY (CANADA) LTD.—Chatham, Ontario

Personals of A.S.A.E. Members

(Continued from page 576)

M. Hamilton Clark recently became executive vice-president and general manager of the Foster Machinery Co., at Albany, Ga., prior to which he was general manager of the Taylor Machinery Co., at Memphis, Tenn.

Merle L. Esmay, formerly in the agricultural engineering department at South Dakota State College, is now doing graduate work in farm structures at Iowa State College, and in addition is engaged on a research fellowship.

A. W. Farrall and W. H. Sheldon are joint authors of a report, entitled "Protection of Crops from Frost Damage Through the Use of Radiant Energy," which appeared in the Michigan Agricultural Experiment Station Quarterly Bulletin for November. Their development of a low-cost, oil-burning unit for this use recently obtained favorable public notice in newspapers in important fruit and truck crop areas.

L. W. Garver is now supervisor of repairs for the Massey-Harris Co., at its general offices in Racine, Wis. Prior to being transferred to Racine, he was for several years branch manager for the company at Columbus, Ohio.

W. A. Junnila recently resigned as research engineer at the Ohio Agricultural Experiment Station to accept appointment as agricultural engineer in the division of farm electrification (BPISAE), U. S. Department of Agriculture. He is to be stationed in the agricultural engineering department of the University of Connecticut at Storrs, where he will engage in research work in farm electrification on a joint project between the University and the USDA.

Clarence F. Kelly, agricultural engineer, (BPISAI), U. S. Department of Agriculture, who has been engaged in grain storage investigations at Iowa State College for the USDA division of farm buildings and rural housing, has been transferred to Davis, Calif., to engage in livestock environmental studies conducted jointly by the USDA and the University of California.

Charles M. Sanders, who served as a captain of infantry during the war, is a civilian again and recently joined the U. S. Soil Conservation Service as drainage engineer at Huntsville, Ala.

Jacob Stefan, Jr., sales manager, Electric Wheel Co., was elected as vice-president of the company at a recent meeting of its board of directors.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Joseph A. Abrahamson, farm manager, Mount Arbor Nurseries, Shenandoah, Iowa.

Abram P. Balzer, Balzer Mfg. Co., Mountain Lake, Minn.

Andrew H. Baxter, Jr., Washington representative, Northeastern Engineering, Inc. (Mail) 1745 K St., N. W., Washington 6, D. C.

Rudy H. Beckman, sales engineer, Electric Wheel Co., Quincy, Ill.

John A. Bird, associate editor, "Country Gentleman", Philadelphia 3, Pa.

William C. Bolton, agricultural engineer, applications and loans div., Rural Electrification Administration, USDA, Washington 25, D. C. (Mail) Region 10.

Charles T. Bourns, graduate student in agricultural engineering, A. & M. College of Texas, College Station, Texas. (Mail) P. O. Box 891.

William C. Buchanan, rural service engineer, Appalachian Electric Power Co. (Mail) Marion, Va.

William Buchinger, farm service engineer, The Detroit Edison Co., 2000 2nd Ave., Detroit, Mich.

James R. Cobb, assistant chief, applications and loans div., Rural Electrification Administration, USDA, Washington 25, D. C.

William E. Code, associate irrigation engineer, Colorado A. & M. College, Fort Collins, Colo.

Keller Cordon, agricultural field representative, Portland Cement Assn. (Mail) 930 Bluemont, Manhattan, Kansas.

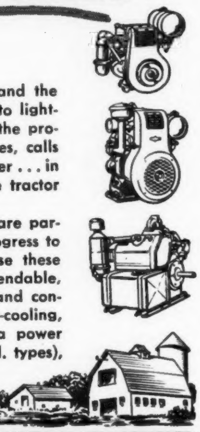
Ben R. Day, agricultural engineer, Soil Conservation Service, USDA. (Mail) Box 188, Rising Star, Texas.

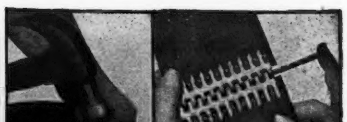
George A. Dunham, district engineer, Soil Conservation Service, USDA. (Mail) P. O. Box 248, Bristol, Vt.

Felix E. Edwards, associate professor of agricultural engineering, Mississippi State College, State College, Miss.

Ralph C. Frevik, project engineer, Harry Ferguson, Inc., Detroit, Mich. (Mail) 12735 Appoline, Detroit 27.

Mark M. Gehl, plant manager, Gehl Bros. Mfg. Co., West Bend, Wis. (Mail) 1055 Poplar St. *(Continued on page 580)*





Applicants for Membership

(Continued from page 578)

Lamoyne Goodwin, farm representative, Gulf States Utilities Co., Beaumont, Texas.

Russell J. Gingles, manager, farm electrification bureau, National Electrical Manufacturers Assn., 155 East 44th St., New York 17, N. Y.

Paul H. Harrer, designer, harvester division, Allis-Chalmers Mfg. Co., LaPorte, Ind. (Mail) R. R. No. 1, Box 164.

Francis J. Hassler, graduate assistant in agricultural engineering, Michigan State College, East Lansing, Mich.

Herbert Henriques, eastern manager, Flood Co., 560 North 16th St., Philadelphia 30, Pa.

Mars M. Hornish, consumer relations dept., International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.

John H. Hough, field engineer, Southern Pine Assn., Box 1170, New Orleans, La.

W. F. Hutchins, rural service representative, West Penn Power Co. (Mail) Ridgway, Pa.

Roy Jordan, field engineer, Agricultural Designers, Inc., 631 Terminal Tower, Cleveland, Ohio.

Arnold A. Knecht, soil technologist, Bureau of Reclamation, USDI. (Mail) 2510 M. Street, Bakersfield, Calif.

St. Clair A. Knight, Jr., Box 125, Summerville, S. C.

Virgil A. Michael, architectural engineer, Farmers Home Administration, 950 Broadway, Denver, Colo.

John E. Loveland, purchasing agent, refrigeration div., Central Supply Co., 210 South Capitol, Indianapolis, Ind.

Edward G. Molander, senior agricultural engineer (BPISAE), U. S. Department of Agriculture, Agricultural Research Center, Beltsville, Md.

William N. Muir, farm service engineer, Detroit Edison Co. (Mail) 1212 Gunn Road, Box 168, Rochester, Mich.

John T. Murphy, project engineer, Harry Ferguson, Inc. (Mail) 13220 Woodward Ave., Highland Park 3, Mich.

Claude L. Newhart, jobber representative, Louden Machinery Company. (Mail) 694 Bateman St., Galesburg, Ill.

Gordon W. Olson, construction engineer, Palmer Terracing Co., Malvern, Iowa. (Mail) Box 514.

Jackson W. Payne, soil conservation, Soil Conservation Service, USDA. (Mail) Hawkinsville, Ga.

Harihar N. Shukla, associate agricultural engineer, U. P. Government (India). (Mail) Agricultural Engineering Dept., University of Minnesota, University Farm, St. Paul 1, Minn.

Gurcharn Singh graduate student in agricultural engineering, University of Illinois, Urbana, Ill. (Mail) 207 Central Ave.

Frank S. Stennett, land-use specialist, Bureau of Reclamation, USDI. (Mail) 2510 M. Street, Bakersfield, Calif.

Everett H. Thomas, agricultural development agent, Great Northern Railway, 817 Old National Bank Bldg., Spokane 8, Wash.

Roy T. Tribble, graduate student in agricultural engineering, Michigan State College, East Lansing, Mich.

P. E. Wadsworth, vice-president and general manager, The Van Brunt Mfg. Co., Horicon, Wis.

Ralph W. Walter, farm equipment engineer, Wisconsin Power and Light Co., 122 W. Washington Ave., Madison, Wis.

F. Richard Willsey, farm safety specialist, Purdue University, Lafayette, Ind.

D. S. Young, district manager (field irrigation), Portland General Electric Co. (Mail) R. R. No. 2, Box 50, Sherwood, Ore.

TRANSFER OF GRADE

Chester O. Anderson, work unit conservationist, Soil Conservation Service, USDA. (Mail) Creighton, Neb. (Junior Member to Member)

Henry E. Berns, service manager, Batavia Branch, The Massey-Harris Co., Inc. (Mail) Elba, N. Y. (Junior Member to Member)

Joseph H. Bodwell, rural service representative, New Hampshire Gas & Electric Co., 46 Congress St., Portsmouth, N. H. Associate to Member)

John C. Bursik, assistant professor of agricultural engineering, Oregan State College, Corvallis, Ore. (Mail) 611 North 11th St. (Junior Member to Member)

H. T. Hargrave, ranch foreman, Hargrave Ranching Co., Walsh, Alberta, Canada. (Junior Member to Member)

E. A. Hodge, rural service consultant, Louisiana Power & Light Co., 142 Delaranda St., New Orleans 14, La. (Junior Member to Member)

R. M. Ramp, agricultural engineer (BPISAE), USDA. (Mail) P. O. Box 470, Houma, La. Junior Member to Member)

Lawrence R. Swarmer, agricultural engineer, Bureau of Reclamation, USDI. (Mail) Box 937, Boise, Idaho. (Junior Member to Member)

John P. Spielman, agricultural engineer, Rural Electrification Administration, USDA., Washington, D. C. (Junior Member to Member)

Thomas H. Weeks, field engineer, Buell & Winter (consulting engineers). (Mail) Centerville, S. D. (Junior Member to Member)

John H. Zich, service engineer, Harry Ferguson, Inc., Detroit 3, Mich. (Mail) 8233 Coyle Ave., Detroit 27. (Junior Member to Member)

Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings, is not intended to imply any specific level of proficiency, or registration or license as a professional engineer.

NOTE: In this Bulletin the following listings still current and previously reported are not repeated in detail. For further information see the issue of AGRICULTURAL ENGINEERING indicated.

Attention is invited to the desirability of checking on the housing situation when considering a new location.

POSITIONS OPEN: MAY—O-499, 500, 502, 503. JUNE—O-506. AUGUST—O-510, 511. SEPTEMBER—O-516, 520, 521. NOVEMBER—O-523, 524, 525.

POSITIONS WANTED: FEBRUARY—W-207, 210, 254. APRIL—W-232, 237, 240, 258, 262, 276, 292. MAY—W-309, 312. JUNE—W-316, 319, 320, 321, 322. JULY—W-327. SEPTEMBER—W-336, 337, 341, 346. OCTOBER—W-348, 351, 352, 353. NOVEMBER W-354, 355, 356, 358, 359.

POSITIONS OPEN

AGRICULTURAL ENGINEER extension specialist in farm structures, for work in corn belt state. BS deg in agricultural engineering, or equivalent, required. MS deg and any good experience in this or related fields would be helpful, but not required. Man with strong interest in farm structures and capacity for development preferred. Opportunity provided for development in subject matter and extension techniques. Opening to be filled by Jan. 1 if possible. Age, under 35. Salary open. O-526

AGRICULTURAL ENGINEER for research in rural electrification in corn belt state. BS deg in agricultural engineering, or equivalent, required. MS deg and any good experience in this or related fields would be helpful, but not required. Man with strong interest in rural electrification and capacity for development preferred. Opportunity provided for development in subject matter and research techniques. Opening to be filled by Jan. 1 if possible. Age, under 35. Salary open. O-527.

AGRICULTURAL ENGINEER (instructor rank) for full time teaching in soil and water conservation field, in a state university in the Southeast. BS deg in agricultural engineering, or equivalent, required. MS deg and teaching experience or field work in soil and water conservation desirable but not essential. Usual personal qualifications for college teaching. Opening effective Jan. 1, 1947. Salary, up to $2700, 12 month basis. O-528

AGRICULTURAL ENGINEER (instructor or assistant professor rank) for full time teaching in engineering drawing, descriptive geometry, forestry drawing, and surveying, in a state university in the Southeast. BS deg in agricultural engineering, or equivalent required. MS deg and experience in teaching, drafting, or surveying desirable but not essential. Usual personal qualifications for college teaching. Opening effective Jan. 1, 1947. Salary up to $3600 to start, 12 month basis O-529

AGRICULTURAL ENGINEER (instructor or assistant professor rank) for teaching and research in farm power and machinery in a state university in the Southeast. BS deg in agricultural engineering, or equivalent, required. MS deg and some experience in power machinery field, in teaching, extension, research, or commercial work, desirable but not essential. Usual personal qualifications for college teaching and research. Opening effective Jan. 1, 1947. Salary, up to $3600, 12 month basis. D-530

AGRICULTURAL ENGINEER (instructor rank) for teaching farm carpentry and buildings in a state university in the Southeast. BS deg in agricultural engineering, or equivalent, required. MS deg highly desirable. Must be industrious, good organizer, good natured, and cooperative. Practical experience desirable. Opportunity for advancement to professor rank. Age 25-35. Salary $2400 - $3200 for 11 months. O-531

SALES ENGINEER on irrigation, hay drying, and domestic water system equipment, for long-established wholesale farm equipment distributor in east central territory. BS deg in agricultural engineering, or equivalent, with farm background and some agricultural or mechanical engineering experience desired. Must be aggressive, willing to work, honest, neat, and able to get along with others in the organization. Age 25-50. Salary $3600, plus commissions for man who shows ability to handle the job. O-532

PROJECT ENGINEER for design and development work on tractors for established manufacturer in the North central area. Prefer graduate in agricultural or mechanical engineering with several years experience in designing tractors or related automotive equipment and good knowledge of tractor operated equipment. Age 30-45. Salary $4800 - $7200. O-533.

SENIOR LAYOUT DRAFTSMAN for tractors and component parts, for established manufacturer in north central area. Prefer graduate mechanical engineer or equivalent, with four or five years experience in design of tractors or engines. Familiarity with shop practice and materials is essential. Age 25-45. Salary, about $4800. O-534

POSITIONS WANTED

AGRICULTURAL ENGINEER desires teaching or research in a college or university. BSAE degree, Kansas State College, 1946. Experience in aircraft production, in teaching aircraft metal work and related subjects, in handling men, and as test engineer in aircraft industry. Minor injury to one foot, which is no handicap to work. Available on two or three weeks notice. Married. Age 25. Salary $3000. W-360

(Continued on page 584)

Self-Propelled makes history again ...in terms of saving labor and time

At corn picking time this fall corn belt farmers saw an entirely new machine for handling corn . . . a corn picker that was neither mounted nor drawn . . . that followed the rows like a hound follows the trail . . . that knocked down not a single stalk, even in opening up the fields . . . that eliminated all hand husking . . . that got more corn . . . that delivered it cleaner to the wagon . . . that couldn't be bluffed by wet fields and tough conditions.

That machine is the *Massey-Harris* Self-Propelled Corn Picker.

As revolutionary as the Massey-Harris Self-Propelled Combine is in the harvesting of grain, this new corn picker puts the handling of corn on a high production, high speed basis. With a daily capacity of 20 to 30 acres in 50-bushel corn — 50 to 75 per cent greater than that of conventional machines — it takes the work — and the danger — out of one of the toughest jobs on the farm.

The Massey-Harris Self-Propelled Corn Picker *is* a safe machine . . . as *safe* as human ingenuity can make it. The operator is away from all moving mechanisms. His controls are right at his finger tips. No reaching, no stretching. No looking around. No guesswork in following the rows — they're right in front of him and below him.

Since 1847 Massey-Harris has been a leader in developing new and better farm equipment. The power-plus tractors, the self-propelled combine, the straight-through separation of the rasp-bar cylinder, the forage harvester that handles any hay or ensilage crop — these are only a few of the outstanding developments of Massey-Harris engineering and research.

Get acquainted with the Massey-Harris dealer in your community. He will be glad to give you any information you want on the complete line of Massey-Harris Farm Equipment. *Keep your eye on Massey-Harris.*

THE MASSEY-HARRIS CO.

General Offices: Racine, Wis.

MASSEY M-H HARRIS

TRACTORS
COMBINES
IMPLEMENTS

PROFESSIONAL DIRECTORY

RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of $1.00 per line per issue; 50 cents per line to A.S.A.E. members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.

PERSONNEL SERVICE BULLETIN

(Continued from page 582)

AGRICULTURAL ENGINEER desires research in a land grant college, in the power and machinery or soil and water field. BSAE degree, Alabama Polytechnic Institute, 1941. MSAE degree expected March, 1947. One year experience in research on soil physics as it affects farm machine design. Over 4 years commissioned service in Field Artillery. No physical defects. Available April 1, 1947. Married. Age 28. Salary open. W-361.

AGRICULTURAL ENGINEER desires teaching, research, or extension work in a land grant college, in farm structures or soil and water field. BSAE degree, Mississippi State College, and MSAE degree, Iowa State College, with major in farm structures and minor in structural engineering. Six summers AAA land survey work; 9 months research in farm structures, 4½ years Army Engineer Corps, mostly commissioned service; 1½ years engineering, Soil Conservation Service. No physical defects. Available on one month notice. Married. Age 28. Salary $3300. W-362

AGRICULTURAL ENGINEER desires teaching or extension work in power and machinery or soil and water field; or sales and service in farm equipment field. BSAE degree, Michigan State College, 1940. Experience in farm store sales and customer service; and 5 years commissioned service in Army. No physical defects. Available, spring 1947. Married. Age 31. Salary $3500. W-363

AGRICULTURAL ENGINEER desires research or sales engineering work in soil and water field; or engineering in the processing of farm products. BSAE degree, University of Tennessee. Experience, 3 months surveying in TVA, and nearly 3 years in Army, partly commissioned. No physical defects. Available January 1947. Single. Age 24. Salary $2800. W-364

AGRICULTURAL ENGINEER desires sales or extension work in farm structures field; or sales engineering or development in power and machinery field. Also open to sales work in Far East, in agricultural engineering and transportation fields. BSAE degree, University of Tennessee. Experience as junior draftsman in office of rural architect, University of Tennessee; and as an officer in the Army. No physical defects. Available immediately. Married. Age 27. Salary open. W-365.

AGRICULTURAL ENGINEER desires educational or project work in soil and water field; or farm structures work in private industry or public service. BSAE degree, University of Tennessee, expected December 1946. Experience as instrument man, and chief of party on various surveying jobs. Army duty more than 3 years, field commission. No physical defects. Available January 1947. Married, Age 33. Salary $3300. W-366

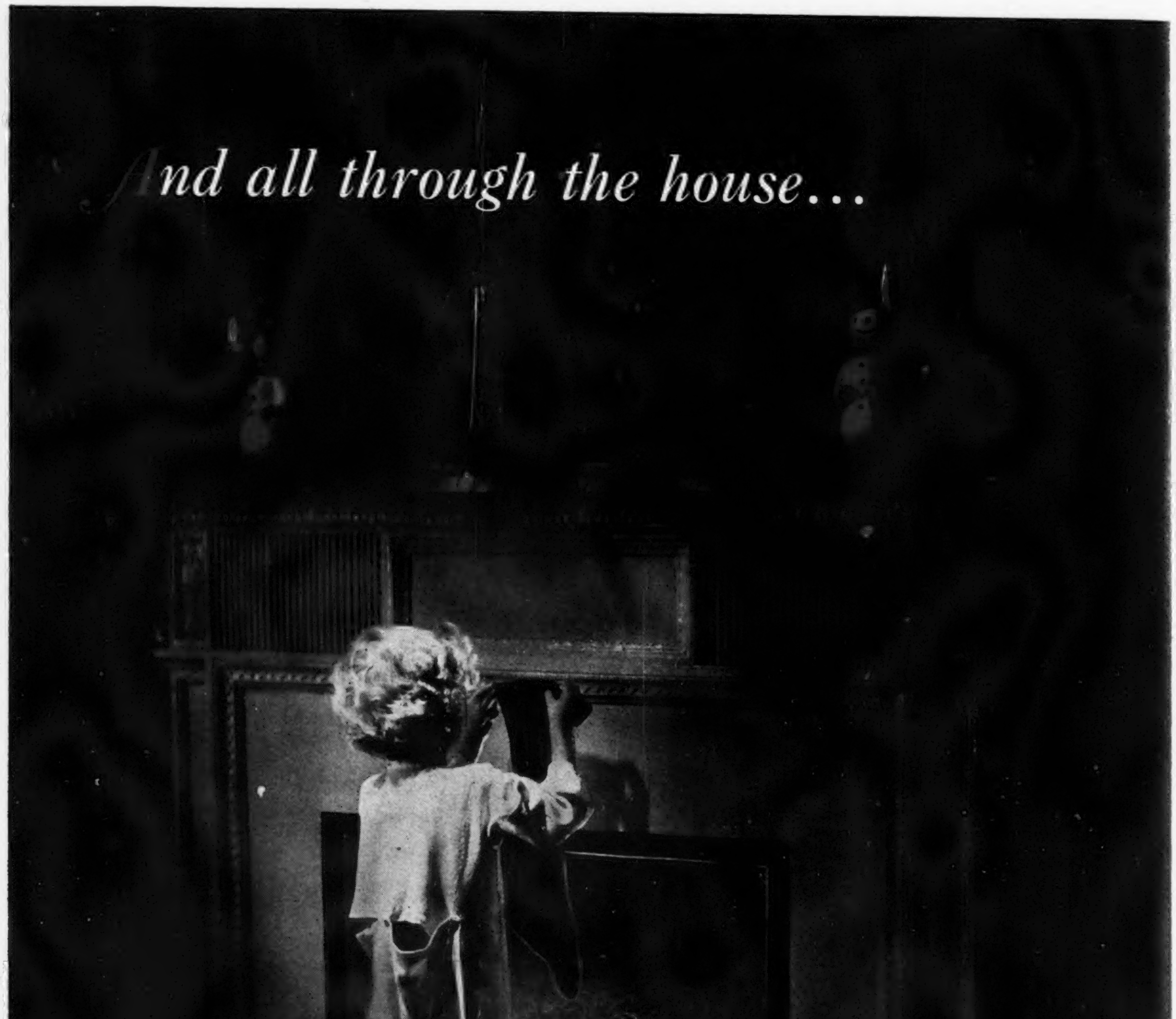
AGRICULTURAL ENGINEER desires development or research work in the power and machinery field, in public service or private industry, with opportunity for further study. BSAE degree, Macdonald College, Province of Quebec, Canada, expected April 1947. Farm reared in Western Canada. Several years experience with commercial equipment in highway and airport construction. Nearly two years commissioned service in RCAF. No physical defects. Available May 5, 1947. Married Age 31. Salary open. W-367.

New Literature

LET'S PRACTICE SOIL CONSERVATION. Paper, 24 pages, 8½x10¾ inches, illustrated. International Harvester Co. Farm practice guidance covering the need for erosion control, land classification and land use, soil conservation practices, terraces, strip cropping, contour farming, and farm ponds.

NEW RICHES FROM THE SOIL, by Wheeler McMillen, editor-in-chief, "Farm Journal". (Cloth, xii+397 pages, 5¾x8 inches. Indexed. D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, $3.00). A narrative of the progress of chemurgy, told with the enthusiasm and sound foundation of agricultural economics characteristic of Mr. McMillen's approach to the subject. The account is divided into three parts covering the origin and early history; applications and development in specific areas, crops, and products; and recent organization, progress, and economic and social significance. Part two, on specific developments, covers the application of chemurgy to cigarette paper production, corn, corncobs and oat hulls, soy beans, new crops for wheat and cotton lands, cotton, the Everglades, oils, fibers, wood, animal chemurgy, alcohol, rubber, and a miscellany of minor developments.


A GREAT EDUCATIONAL FILM WITH LAUGHS AND THRILLS
"JUST A FARMER"
TEXACO'S NEW ALL-STAR FARM MOVIE
With a Great Cast From Hollywood and Broadway
Marylin Sable, as "Helen" starred in "Kiss and Tell", "Snafu", "Dear Ruth" and other Broadway hits
Zita Johann as "Aunt Grace" starred in Broadway play, "Tomorrow and Tomorrow", played opposite E. G. Robinson, George Brent, Boris Karloff, in Hollywood production
Alexander Campbell as "Uncle Dick" has had 32 years of Broadway experience in many great plays
This great heart-warming movie, dramatizes a common farm family problem and in so doing glorifies the farmer, inspiring better farm practices and showing him what some of them are. A few extra copies of the film will be available for use by educators at their farm meetings or for class room instruction. If you are interested write the nearest Texaco office listed below.
THE TEXAS COMPANY
TEXACO
REG.T.M.
Tune in . . . TEXACO STAR THEATRE presents the new Eddie Bracken show every Sunday night. METROPOLITAN OPERA broadcasts every Saturday afternoon. See newspapers for time and stations.
IT PAYS TO FARM WITH TEXACO PRODUCTS
DIVISION OFFICES: Atlanta 1, Ga.; Boston 17, Mass.; Buffalo 3, N. Y.; Butte, Mont.; Chicago 4, Ill.; Dallas 2, Tex.; Denver 1, Colo.; Houston 1, Tex.; Indianapolis 1, Ind.; Los Angeles 15, Calif.; Minneapolis 2, Minn.; New Orleans 6, La.; New York 17, N. Y.; Norfolk 1, Va.; Seattle 11, Wash.
Texaco Products also distributed by McColl-Frontenac Oil Company, Limited, Montreal, Canada


And all through the house...
...Flintkote Building Materials